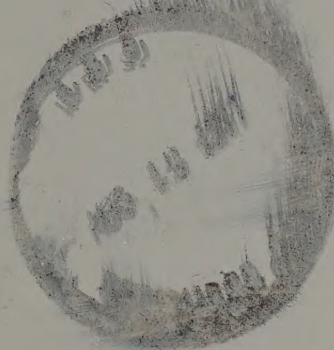


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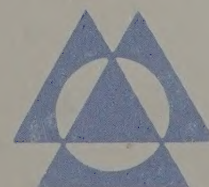


REPORT AND RECOMMENDATIONS

JUNE, 1977

Alberta

ENVIRONMENT CONSERVATION AUTHORITY





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FLOW REGULATION OF THE RED DEER RIVER

REPORT AND RECOMMENDATIONS

JUNE, 1977

Alberta
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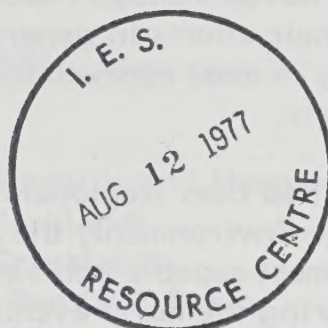
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ENVIRONMENT CONSERVATION AUTHORITY

June 30, 1977

Lieutenant Governor in Council,
Legislative Building,
Edmonton, Alberta

Honourable D.J. Russell,
Minister
Department of the Environment,
222 Legislative Building
Edmonton, Alberta



Dear Sirs:

I have the honour to transmit herewith, the final Report and Recommendations of Environment Conservation Authority on Flow Regulation of the Red Deer River, as required by Section 7(1) (e) of The Environment Conservation Act, (Chapter 125, R.S.A. 1970 with amendments to June 6, 1974).

I have the honour to be, Sirs,

Your obedient servant,

J.J. Kinisky
J.J. Kinisky,
Acting Chairman,
Environment Conservation Authority

JJK/Ih
Attach.

ACKNOWLEDGEMENTS

The Environment Conservation Authority once more expresses its gratitude to the many individuals who contributed their time, energies and talents towards the Authority's Public Hearings on Flow Regulation on the Red Deer River, as well as to the many who added to their numbers during the second round of hearings.

Once again the Authority was favoured, during the preparatory stages, by the contributions of the local Public Advisory Committee on the Red Deer River, the Raven Valley Preservation Association and the Site 6 Association with their efforts in generating interest in the hearings. The Authority is most appreciative of these and the personal efforts of many individuals.

To the staff of the Red Deer Regional Planning Commission and the Alberta Department of the Environment, the Authority expresses its special thanks for their most capable and valued support not only during the hearings but also during the many evening information meetings held throughout the area in the weeks preceeding the hearings.

Finally, to the many persons who supported the Authority's Information Centres, the participants of all ages who often made long journeys to participate, and its own staff for their loyal support, the Authority wishes to say a sincere "Thank You."

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1. INTRODUCTION

Water is one of the most important resources in Alberta and is utilized for a wide variety of purposes. The basic uses of water in the province and their order of social importance are outlined in the Water Resources Act. Under this legislation, water is allocated first for domestic drinking, secondly for municipal use, thirdly for agriculture, fourthly for industrial purposes, and finally for other, largely nonconsumptive, uses such as recreation and wildlife. To meet these social demands, resource management is required to ensure the availability of water of a certain quantity and quality, together with protection from the hazards of flood and erosion. This task is the responsibility of the Provincial Department of the Environment and in undertaking it for the Red Deer River Basin they face a special set of problems.

Water resource management problems in the Red Deer River Basin stem from the wide seasonal variations in the volume of flow. This characteristic of the river regime presents two sets of contrasting problems. During the winter months both the quantity and the quality of water in the Red Deer River system is reduced, often severely. The volume of water is sufficient to meet with present demands, but may be insufficient to cope with projected increases in urban and industrial growth in the region. Water quality in winter is a pressing problem of the present, with levels of dissolved oxygen in the river often falling below the prescribed standard. During the spring and early summer months these problems disappear with increased flows, but they are sometimes replaced by flood and erosion hazards which threaten agricultural lands and settlements located along the flood plain of the Red Deer River.

To try and alleviate these problems the Provincial Department of the Environment has undertaken extensive studies and put forward a number of management proposals. The initial proposal of the Department to regulate the flow of the Red Deer River by the construction of one or more impoundments at designated sites was invited and the subject of previous Environmental Conservation Authority hearings and of the Environmental Report and Recommendations. The document represents a synthesis of the present findings and a summary of it is included in section 1.2, together with copies of the proposals considered for the hearings mentioned above.



1. INTRODUCTION

Water is one of the most important natural resources of Alberta and is utilized for a wide variety of purposes. The basic uses of water in the province and their order of social importance are spelled out in The Water Resources Act. Under this legislation, water is allocated firstly for domestic drinking, secondly for municipal use, thirdly for agricultural production, fourthly for industrial purposes, and finally for other, largely nonconsumptive, uses such as recreation and transportation. To meet these social demands, resource management is needed to ensure the availability of water of a certain quantity and quality, together with protection from the hazards of flood and erosion. This task is the responsibility of the Provincial Department of the Environment and in undertaking it for the Red Deer River Basin they face a special set of problems.

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To try and alleviate these problems the Provincial Department of the Environment has undertaken extensive studies and put forward a number of management proposals. The initial proposal of the Department to regulate the flow of the Red Deer River by the construction of dam impoundments at designated sites above Innisfail was the subject of previous Environment Conservation Authority hearings and of the Preliminary Report and Recommendations. This document represents essential background to the present hearings and a summary of it is included in section 1.3, together with details of the preparations undertaken for the hearings reported herein.

1.1 HISTORY AND BACKGROUND

The Red Deer drainage area has experienced, through the ages, wide variations in its surface, climate and vegetation activity. Three hundred million years ago, the Red Deer drainage basin was a vast, flat, low-lying area, and the Red Deer River was a small, sluggish stream. The description of these features, the plants that lived upon and the life of the tropical seas and swamps are recorded in geological language throughout the Red Deer basin. The Red Deer basin is a vast, flat, low-lying area, and the Red Deer River was a small, sluggish stream. The description of these features, the plants that lived upon and the life of the tropical seas and swamps are recorded in geological language throughout the Red Deer basin.

Before the arrival of the first man in the Red Deer basin, the land was a vast, flat, low-lying area, and the Red Deer River was a small, sluggish stream. The description of these features, the plants that lived upon and the life of the tropical seas and swamps are recorded in geological language throughout the Red Deer basin. The first man to arrive in the Red Deer basin was a hunter-gatherer, and he lived in a small, simple dwelling. He hunted for food and gathered for his family. The first man to arrive in the Red Deer basin was a hunter-gatherer, and he lived in a small, simple dwelling. He hunted for food and gathered for his family.

1.1.1 Geology

The geology of the Red Deer basin is particularly interesting because of its great variety in geology, topography, and climate. The Red Deer basin is a vast, flat, low-lying area, and the Red Deer River was a small, sluggish stream. The description of these features, the plants that lived upon and the life of the tropical seas and swamps are recorded in geological language throughout the Red Deer basin.

1.1 HISTORY AND BACKGROUND



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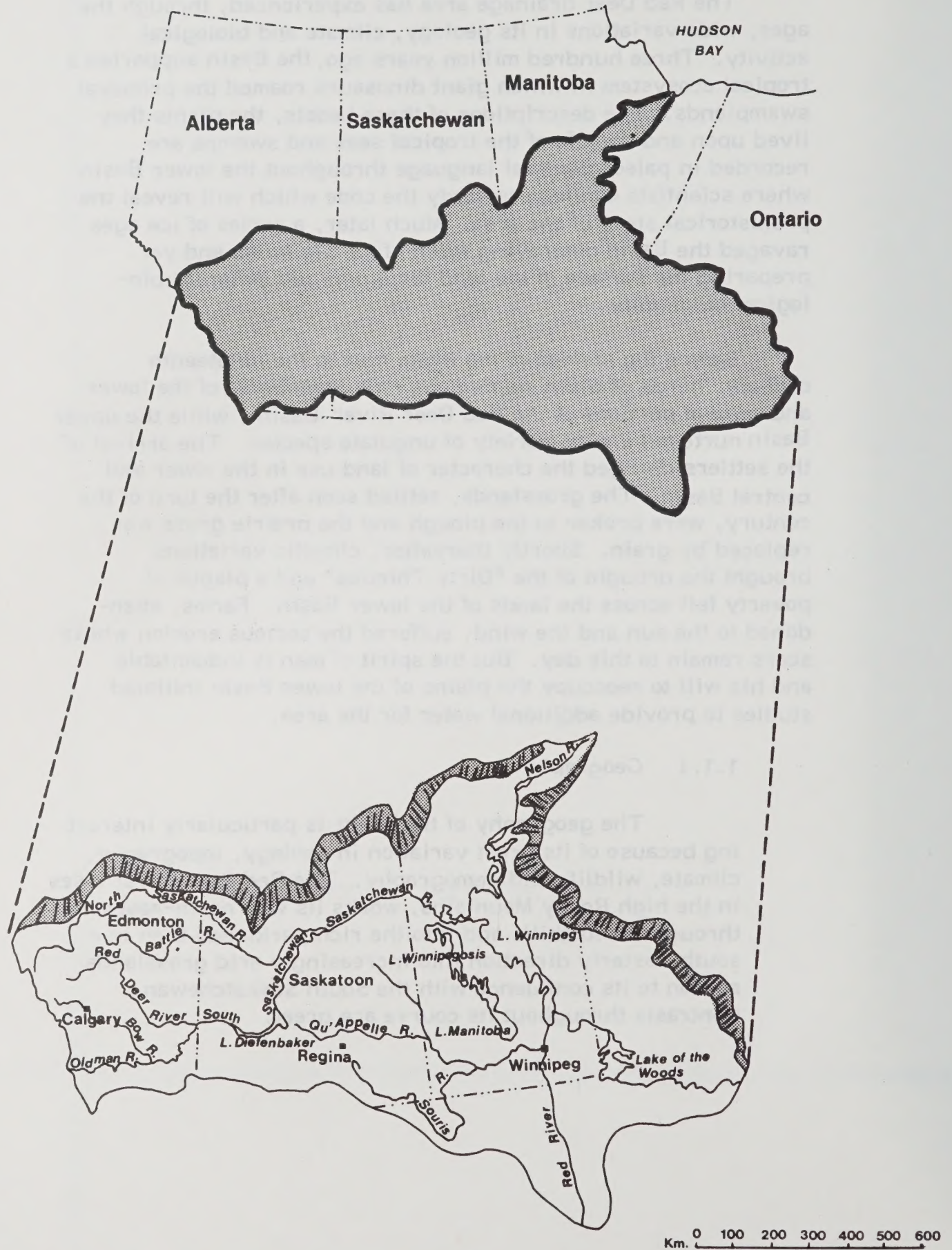
The Red Deer drainage area has experienced, through the ages, wide variations in its geology, climate and biological activity. Three hundred million years ago, the Basin supported a tropical ecosystem in which giant dinosaurs roamed the primeval swamplands. The descriptions of these beasts, the plants they lived upon and the life of the tropical seas and swamps are recorded in paleontological language throughout the lower Basin where scientists continue to study the code which will reveal the prehistorical story of the area. Much later, a series of ice ages ravaged the Basin destroying much of its life forms and yet preparing the surface of the land for a new and different biological community.

Before the arrival of the white man in the nineteenth century, herds of bison roamed the rich grasslands of the lower and central portions of the Red Deer River Basin, while the upper Basin nurtured a wide variety of ungulate species. The arrival of the settlers changed the character of land use in the lower and central Basin. The grasslands, settled soon after the turn of the century, were broken to the plough and the prairie grass was replaced by grain. Shortly thereafter, climatic variations brought the drought of the "Dirty Thirties" and a plague of poverty fell across the lands of the lower Basin. Farms, abandoned to the sun and the wind, suffered the serious erosion whose scars remain to this day. But the spirit of man is indomitable and his will to reoccupy the plains of the lower Basin initiated studies to provide additional water for the area.

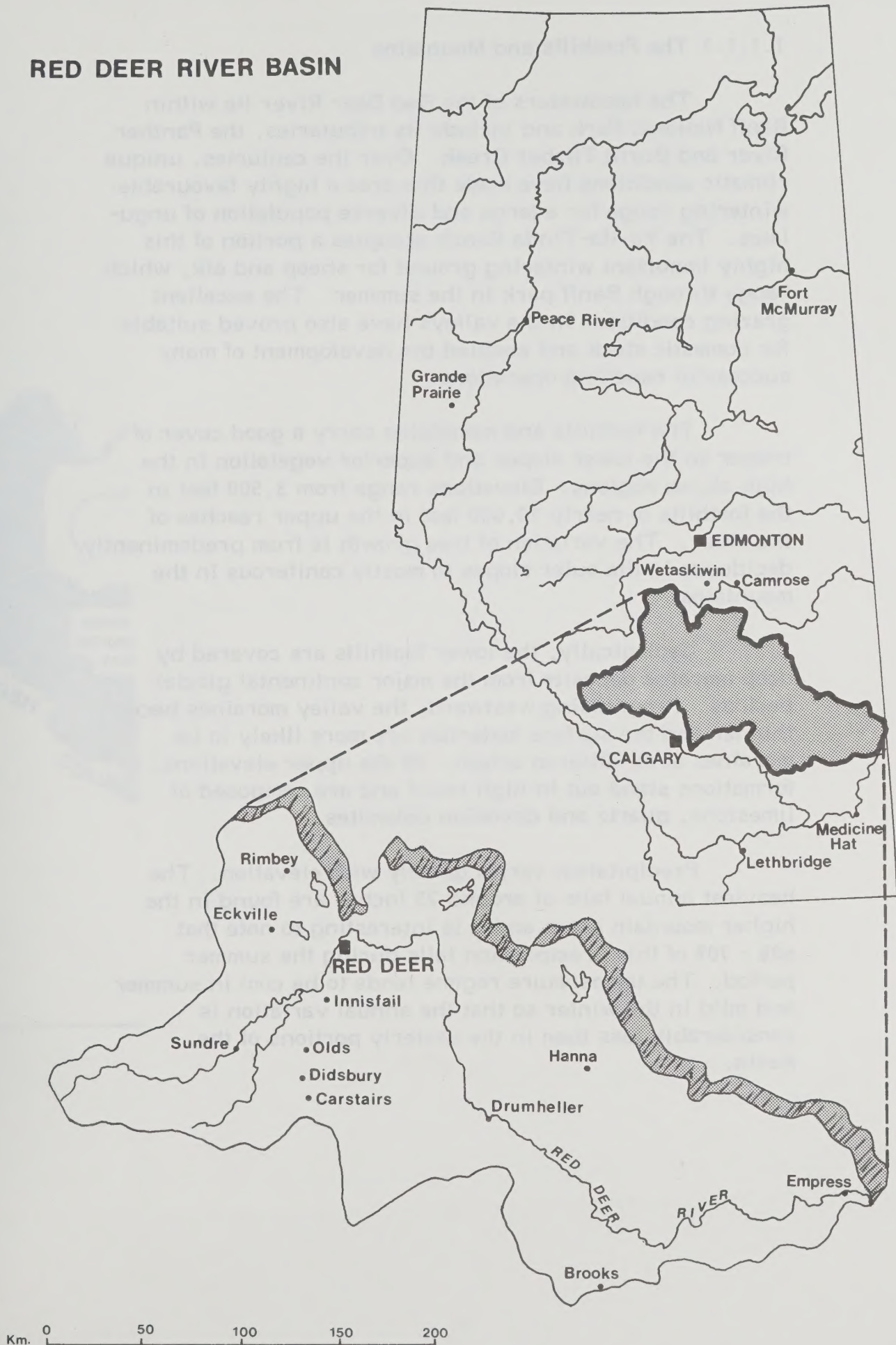
1.1.1 Geography

The geography of the Basin is particularly interesting because of its great variation in geology, topography, climate, wildlife and demography. The Red Deer River rises in the high Rocky Mountains, works its way north-eastward through the foothills and into the rich parkland, then in a south-easterly direction into increasingly arid grasslands and on to its confluence with the South Saskatchewan. Contrasts throughout its course are great.

SASKATCHEWAN - NELSON RIVER SYSTEM



RED DEER RIVER BASIN



1.1.1.1 The Foothills and Mountains

The headwaters of the Red Deer River lie within Banff National Park and include its tributaries, the Panther River and Burnt Timber Creek. Over the centuries, unique climatic conditions have made this area a highly favourable wintering range for a large and diverse population of ungulates. The Ya-Ha-Tinda Ranch occupies a portion of this highly important wintering ground for sheep and elk, which range through Banff park in the summer. The excellent grazing conditions in the valleys have also proved suitable for domestic stock and enabled the development of many successful ranching operations.

The foothills and mountains carry a good cover of timber on the lower slopes and superior vegetation in the high alpine regions. Elevations range from 3,500 feet in the foothills to nearly 10,000 feet in the upper reaches of the river. The variation of tree growth is from predominantly deciduous in the outer slopes to mostly coniferous in the mountains.

Geologically, the lower foothills are covered by deep moraine deposits from the major continental glacial periods. Progressing westward, the valley moraines become thinner and the surface materials are more likely to be moraines of cordilleran origin. At the upper elevations, formations stand out in high relief and are composed of limestone, quartz and devonian dolomites.

Precipitation varies greatly with elevation. The heaviest annual falls of around 23 inches are found in the higher mountain areas and it is interesting to note that 60% - 70% of this precipitation falls during the summer period. The temperature regime tends to be cool in summer and mild in the winter so that the annual variation is considerably less than in the easterly portions of the Basin.

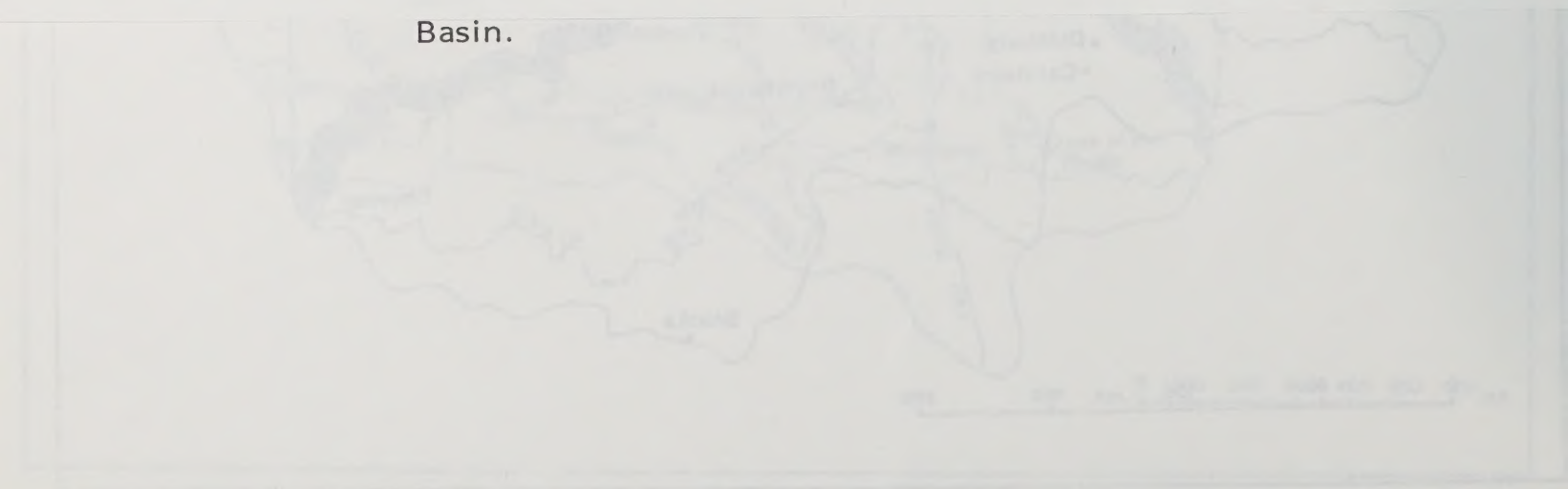
RED DEER RIVER BASIN

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Basin.



1.1.1.2 The Parklands

As the Red Deer River leaves the foothills it courses through the rich parkland which is characterized by increasingly better soils supporting both grasslands and deciduous forests. Major tributaries such as the Little Red Deer, Medicine and Blindman Rivers add to the flow. Throughout this reach of the river, gradients are smaller but the volume of water is greater. Soil types here are more erosion-prone along the banks of the river and evidence of such erosion is visible at and downstream from Sundre.

As the river continues its easterly course, the forests diminish and the grasslands progressively take over. Farming operations are widespread throughout the area but change from predominantly forage production in the far west to cereal grains in the central and easterly parts.

Climatic conditions are not a major constraint on agriculture. Precipitation is adequate throughout this region; however, the short frost-free period in the west inhibits cereal crop production and a high summer hail frequency adversely affects some parts of the region.

1.1.1.3 The Grasslands

The deeply-incised valleys of the grasslands prairie region are indicative of the more erodible soil types. Many tributaries join the Red Deer in this area, but their contribution is mostly restricted to spring runoff and the drainage from heavier summer rain storms. The gradient of the river in these easterly regions is much less than in the areas to the west. Flooding in the lower valley elevations is common as are low water levels in the late summer and throughout the winter.

Vegetation is mainly grassland prairie with some deciduous growth along the water courses. Dry land farming is practised in parts of this area but the average yield is relatively low on a per acre basis, and some areas are used for grass pasture only. Much of the country is sparsely settled and it was an area seriously affected by the drought and wind erosion of the thirties.

Although temperatures here are very favourable to crop production and there is a relatively long frost-free period, lack of rainfall imposes severe limitations.

1.1.2 Land Use in the Red Deer Basin

The land use pattern is a reflection of the combination of soil types, climate and resource availability. Although occupation by man has spanned only a moment in geological time, this impact has been great. The combination of the forest industry, and petroleum in the western regions, and increased human habitation has changed the landscape, the distribution of plant and animal life and the quality and quantity of water in the river.

1.1.2.1 Agriculture

The first sod was broken in the Basin just before the turn of the century. Large tracts of land were cleared of forests and put to the plough thereby greatly altering the characteristics of the central Basin. To the east, the breaking of the sod of the great grassland prairies revealed rich soils which for a time brought high production of cereal crops. However, the arrival of the drought of the 1930s coupled with inferior land management practices left the surface vulnerable to serious soil erosion. Some of the topsoil was swept away and recovery has been slow.

With such changes in the watershed, the character of the river has changed. Floods rise more quickly and low water conditions persist for longer periods.

The quality of the water has also been altered by agricultural practices, especially in the upper Basin. Before the advent of agriculture, the Red Deer Basin produced clean water of good quality and quantity on a more regular basis. Over the past 75 years, forest cover has been reduced so that the delivery of water from the Basin to the river has been accelerated. This has been a factor in the variability of river flows, especially during the spring and summer.

A main impact of agriculture arises from livestock operations. Traditionally, the Red Deer and its tributaries have been used for stock watering. Cattle move onto the banks for water and their waste material is deposited in or near these waters. In winter, watering holes are chopped through the ice and again animal waste is deposited on the ice. There are instances of animal waste being dumped in the river or on the ice for disposal. The Authority toured the tributaries just upstream of Red Deer and noted that some of these practices were not uncommon. Such practices can be expected to have an adverse effect on the quality of the water in the tributaries and in turn, on the river itself.

1.1.2.2 Forestry

After the major clearings which took place in conjunction with agricultural settlement, forestry operations slowed down. Timber stands in the area have not supported a major forest industry, although logging for lumber is still practised. Major fires in recent history have left only about 30% of the trees as mature timber. Since about 1940 increasingly effective forest protection has produced a stable condition.

1.1.2.3 Petroleum

The exploration for and the recovery of petroleum products had a major impact on the upper Basin during the '60s. Much of the damage in the form of seismic trails and exploration roads has, however, been repaired through the combined efforts of man and nature, and as a result, the impact on the river is now minimal. Further east, exploration for and recovery of gas, as well as gas and oil processing and secondary recovery operations continue, but these activities mainly in the parkland and grassland prairies appear not to adversely affect the river.

1.1.2.4 Mining

Mining has had a long history in the Basin. In the earlier days of settlement, prairie coals, especially in the Drumheller area, were put to use by the homesteader and later by the railways. Coal became big business in Drumheller but suffered a decline over the years. At the

present time, mining is minimal but with depleting petroleum energy supplies, increased coal mining activity can be anticipated.

Coal exploration continues and has greatly increased over the last five years in both the mountains and the plains. Large deposits east of Red Deer are currently receiving attention with reference to both thermal electric generation and coal gasification.

1.1.2.5 Recreation and Tourism

The whole of the Red Deer valley has good to excellent potential for tourism and recreation. The ancient sea beds, the hoodoos and the remains of the dinosaurs in the Drumheller area make this the most popular tourist attraction after Banff and Jasper in Alberta. The upper portions of the river provide some of the best white water canoeing in Canada while the lower reaches are widely used by canoeing and boating enthusiasts. The foothills area has attracted cottage development while the entire river upstream of Red Deer provides excellent fishing and hunting. Game is plentiful throughout the valley and a full range of ungulate species can be found, including antelope, in the easterly portion.

1.1.2.6 Irrigation

In the lower reaches of the river, climatic conditions are such that irrigation could play a major role in increasing food productivity. Already, some individual growers are taking advantage of these superior climatic conditions and using irrigation for the production of vegetable crops on bench lands adjacent to the river in the Drumheller area.

1.1.2.7 Industrial Development

Until recently, industrial development has been based upon agricultural activity throughout the region. In more recent times, however, industries based upon the processing of natural resources have been growing. Gas processing and sulphur recovery plants in the central and westerly portions of the Basin and more recently the beginning of

construction of a major petrochemical plant has signalled a change toward more industrial emphasis. The gasification of coal in the future could trigger yet another surge in industrial development for the Basin region.

Industrial development in the form of large-scale projects with the view to some growth in dependent industries has been proposed for the region around Red Deer. World demands and market conditions will play a major role in the determination of the industrial future for the Basin.

1.2 PRE-HEARING PREPARATIONS

1.2 PRE-HEARING PREPARATIONS

1.2.1 Information Bulletins

Following the presentation of the Authority's Preliminary Report to the Board of Directors, the Department of Environment and Conservation, in consultation with the Authority, prepared a series of information bulletins. On the basis of these bulletins and background studies and information received by the Department, the Department of Environment and the Authority were able to provide the public with information bulletins summarizing the available material under consideration.

- | | |
|----------------|--|
| Bulletin No. 1 | Continued Public Hearings on Plans for the Red Deer River - Technical Notes and Background Information |
| Bulletin No. 2 | Preliminary Planning Report - Proposed Dam Sites Upstream from Sundre |
| Bulletin No. 3 | Red Deer River - Today and Tomorrow - A Management Statement |
| Bulletin No. 4 | A Preliminary Assessment of Alternatives for a Dam on the Red Deer River |

These bulletins and background reports were placed in the Authority's Information Centres in the area. The information bulletins were distributed by direct mailing to some residents of the area and were also made available to those attending the Information Meetings.

1.2.2 Information Meetings

1.2 PRE-HEARING PREPARATIONS

Throughout the Red Deer River study by the Authority's staff and representatives of the Department of Environment and Conservation, the main intent of these meetings was to ensure ways by which residents within the area might be involved in making presentations to the hearings.

The Authority, through its staff and representatives, made every effort to ensure that all interested parties were informed of the preparations for these meetings.



1.2 PRE-HEARING PREPARATIONS

1.2.1 Information Bulletins

Following the presentation of the Authority's Preliminary Report and Recommendations, the Department of the Environment commissioned a series of studies by private consultants into the areas of concern suggested by the Report. On the basis of these detailed and technical studies and additional research by Department staff, the Department of Environment and the Authority made available to the public four Information Bulletins summarizing the available material under consideration:

- | | |
|----------------|---|
| Bulletin No. 1 | Continued Public Hearings on Flow Regulation of the Red Deer River: Terms of Reference and Background Information |
| Bulletin No. 2 | Preliminary Planning Report on Potential Dam Sites Upstream from Sundre. |
| Bulletin No. 3 | Red Deer River: Today and Tomorrow
A Management Statement |
| Bulletin No. 4 | A Preliminary Assessment of Alternatives to a Dam on the Red Deer River. |

These bulletins and background reports were placed at the Authority's Information Centres in the area. The Information Bulletins were distributed by direct mailing to some residents of the area and were also made available to those attending the Information Meetings.

1.2.2 Information Meetings

Eleven Information Meetings were held in communities throughout the Red Deer River Basin by the Authority's staff and representatives of the Department of Environment during January 1977. The main intent of these meetings was to explore ways by which residents within the area might become involved in making presentations to the hearings.

The Authority wishes to express its gratitude to the local clubs, organizations and individuals who assisted with the preparations for these meetings.

1.2.3 Advertising and Publicity

Following the Information Meetings, the Authority utilized a number of communication techniques including radio and press advertisements to inform the general public of the hearings and in particular the date, time and location of the hearings to be held.

1

1.3 SUMMARY OF PRELIMINARY REPORT AND RECOMMENDATIONS ON FLOW REGULATION OF THE RED DEER RIVER

Public Hearings on Flow Regulation of the Red Deer River were initially held in November and December 1975. The purpose of the hearings, as was indicated in the original terms of reference, was for the Environment Conservation Authority to focus its attention upon the feasibility and environmental impact of construction of a river impoundment at locations investigated in detail by the Alberta Department of the Environment.

Upon completion of the first round of public hearings on Flow Regulation on the Red Deer River the Authority submitted to the Government its interim recommendations which reflected the views expressed by the public through their submissions at Sundre, Innisfail, Spruce View, Drumheller and Red Deer. This was given wide distribution throughout the Basin, the rest of the province, and to regional and provincial government agencies.

1.3.1 Availability of Information

Of the views expressed, one of the most outstanding was that the public did not feel well enough informed on all aspects of the proposal for flow regulation of the Red Deer River. Specifically, it was felt that there was not enough information to arrive at a proper evaluation of alternate sites particularly Site 11 at Sundre. In its interim Report and Recommendations the Authority therefore recommended that Site 11 be studied further by the Department of the Environment to determine the advantages and disadvantages of constructing a reservoir of sufficient capacity at that location to provide effective flow control of the Red Deer River, as well as evaluating the potential of such a dam for hydroelectric power generation.

The Authority recognized that until a study of the feasibility of Site 11 was submitted for consideration, the construction of a dam at Site 6 or 7 and a final recommendation on any specific site for flow control should be deferred. A majority of the submissions presented to the Authority were strongly opposed to construction of a dam at either site 6 or site 7.

1.3.2 The Need for Flow Regulation

Another major item of discussion at the initial public hearings concerned the actual need for flow control of the Red Deer River. Various factors were presented to indicate that some form of flow control was desirable. These included assured water quality and quantity, flood control, irrigation needs, and the assurance of an open-ended future for the Basin. In an independent public opinion survey commissioned by the Authority after the first series of hearings, about 60% of the people polled felt that it was necessary to control the flow of the river now, and about 82% felt it would become necessary in the future. These views were similarly expressed at the public hearings.

In response to these concerns the Authority concluded that some measure of flow control would probably be wise, prudent and necessary to protect the best interests of the residents of the Basin and the Basin itself. The Authority also recognized that flow control, if properly introduced and initiated, could provide remedies to some of the problems now present in the Basin, and could ameliorate more intensive problems that might otherwise arise in the future. To provide additional information on the needs for water in the different parts of the Basin, it recommended that the entire Basin, including the towns and cities, continue to be assessed and that the citizens of the Basin be encouraged to look at the water needs of the Basin as a whole.

1.3.3 Flooding and Erosion

In response to concerns that were expressed about flooding and erosion, the Authority recommended "that the need for flood control now and in the future through all reaches of the Basin be examined more comprehensively than has yet been done, with special attention to the problems of flood plains," and "that flow control for the Red Deer River be provided so as to resolve the conflicts and meet the needs of all sections of the Basin and its inhabitants from the risks and damage of floods and erosion."

1.3.4 Land Use and Water Management

Another issue that the public and the Authority considered to be of utmost importance was land use. The presentations and briefs submitted indicated a strong awareness that land use and water management are closely inter-related and interdependent. Very high value was placed on agricultural land and it was pointed out that there is a need for an integrated land use and water management system for the Basin. These concerns led the Authority to establish recommendations calling for an integrated land use, resource development and water management system to be developed for the Red Deer River Basin.

1.3.5 The Role of the Regional Planning Commissions

The Authority considered that the Regional Planning Commissions were the organizations which could most effectively handle an integrated land use, resource development and a water management system for the area and it accordingly, recommended that they be charged with this responsibility. In the same vein, a recommendation to consider making the boundaries of Regional Planning Commissions more closely coincident with the boundaries of the major drainage basins, was formulated.

1.3.6 Industry and Future Employment

In its interim Report and Recommendations the Authority also recommended that further diversification of the employment and productivity base within the Red Deer Basin be recognized as an important future need. Such factors as suitable small secondary industries, the tourist resource, more intensive development of the bottom lands in the central and eastern portions of the Basin and the prudent and cautious development of depletable subsurface resources were included in this recommendation.

Specific recommendations were also made that heavy industry be located only on low class agricultural land, wherever possible, and that forest operations in the western reaches of the Basin should be done so as not to impair watershed management.

2. THE PUBLIC RESPONSE



2.1 ATTENDANCE AND PARTICIPATION

The hearings conducted in 1977 were very well attended throughout the Red Deer River Basin, with representation being somewhat higher at the City of Red Deer and at upstream locations. A total of 1,188 people attended and presented 156 individual briefs. Submissions were made by all age groups and by people from a broad spectrum of backgrounds. Special mention should be made of the high school students who presented well thought-out and researched briefs with commendable skill. The only sector which apparently chose not to make submissions was industry, in spite of the fact that the major projected water demands were for industrial purposes.

The Authority is pleased to report that the submissions made to these public hearings were competent, well informed and strong in expression. This reflects the high degree of public interest in the subject.

2.1.1 Community Spirit and Way of Life

Many briefs contained expressions of the desire to maintain the spirit of human community which is well developed, especially in that portion of the Basin, at and above the City of Red Deer.

The rural residents were effective farmers with strong historical roots and a proud heritage, together with the strong desire to preserve a way of life which is in harmony with the environment. The desire to preserve this way of life was expressed with pride by the elders and in many cases enthusiastically supported by the youth. Some of these young people were prepared to take strong positions to guarantee a heritage promised to them from as far back as four generations.

2.1.2 Regional Diversity

There was not unanimity throughout the Basin. The concerns in the lower Basin were registered in different ways and the recommendations reflected the need for solutions to more local problems. The people of the Stettler area expressed community needs for an enhanced recreational capability which would result from stabilization of Buffalo

Lake. Some senior citizens of this area provided an interesting review of the history of Buffalo Lake. They expressed the opinion that deteriorating water quality was because of highly fluctuating water levels, rather than added nutrient loads from agricultural operations.

At Drumheller some apprehension was expressed over flood dangers which have historically been shown to be real. At the same time, municipal water supplies have experienced problems both from turbidity at times of high flows and scarcity during low flow. A growing market garden industry expressed its difficulty with water withdrawals at times of very low, late summer flows.

2.1.3 Government Involvement

The Authority wishes to commend the Department of the Environment for the detailed information it was able to supply in response to questions at the hearings. This fine effort involved a number of persons in the Department of the Environment and the Authority would specifically cite the contributions of the Assistant Deputy Minister, Mr. P. Melynychuk and the Senior River Basin Planner, Mr. A. McPhail.

2.1.4 The Consensus

The Authority is faced with making recommendations which best suit the needs of the entire Basin in the face of somewhat different needs and opinions. These differences are expressed in statistical manner in the ensuing section, which treats the concerns of Basin residents on a regional basis.

2.1 ANALYSIS OF CONCERNS

An analysis of the public opinion expressed in the hearings was based on Codrington's analysis of the issues raised by the public. The analysis was based on the following criteria: the nature of the issues raised, the nature of the concerns expressed, the nature of the solutions proposed, and the nature of the actions requested. The analysis was based on the following criteria: the nature of the issues raised, the nature of the concerns expressed, the nature of the solutions proposed, and the nature of the actions requested. The analysis was based on the following criteria: the nature of the issues raised, the nature of the concerns expressed, the nature of the solutions proposed, and the nature of the actions requested.

2.1.1 The Nature of the Issues

Public hearings were held at six locations and a total of 156 responses were received: 113 by letter, 23 by phone, and 20 from groups and organizations. A breakdown of these figures by location and type of input is provided in the table below.

TABLE 1

LOCATION	NO. OF LETTERS	PRESENTED BY INDIVIDUALS	PRESENTED BY GROUPS, OR ORGANIZATIONS
SPRUCE VIEW	24	21	3
SUNDOPE	13	8	5
RED OAK	25	20	5
BRISTOL	11	10	1
CRUMHOLLER	18	10	8
STETTLEN	12	7	5

2.2 ANALYSIS OF CONCERNS

The figures presented do not include responses from Department of Environmental representatives or from consultants called in to give technical evidence, however, where experts expressed obvious value judgments based on their own reference, they are included.

The following table shows the concerns expressed by the public in the following order:



2.2 ANALYSIS OF CONCERNS

An analysis of the public opinion expressed at the hearings based on Codinvolve, a system of content analysis, was undertaken by the staff of the Authority. The ultimate product of this system is a set of tables which objectively summarize input in relation to the key questions addressed by the Authority. Only what was actually said is displayed. No attempt is made to interpret opinion. A more subjective interpretation is undertaken in the text since there are a number of instances in which opinion on issues was partially or obliquely expressed. No weighting is assigned to input, however, although about 30% of the briefs received were from groups, and in one case a petition with 1,100 signatures was submitted.

2.2.1 The Nature of the Input

Public hearings were held at six locations and a total of 156 separate briefs were received; 113 by individuals and 43 from groups and organizations. A breakdown of these figures by location and type of brief is provided in the table below.

TABLE 1

<u>LOCATION</u>	<u>NO. OF BRIEFS</u>	<u>PRESENTED BY INDIVIDUALS</u>	<u>PRESENTED BY GROUPS, ORGANIZATIONS</u>
SPRUCE VIEW	28	21	7
SUNDRE	13	8	5
RED DEER	65	46	19
INNISFAIL	21	19	2
DRUMHELLER	16	10	6
STETTTLER	13	9	4

The figures portrayed do not include responses from Department of Environment representatives or from consultants called on their behalf to give technical evidence; however, where experts expressed obvious value judgements on broad issues beyond their term of reference, they are included. The figures also include inputs by the same individuals at different hearings although these are analyzed as a single input in the following sections.

2.2.2 The Goals and Rationale of Flow Regulation

The portion of the input which focussed on the objectives and rationale of the flow regulation was the most difficult to analyze. It was the broadest and most open-ended issue and discussion tended to range widely. For the purposes of analysis, two integrative themes were identified.

2.2.2.1 Debate About Industrialization (Table 1.1)

The first was a discussion which went beyond examining the rationale behind flow regulation and its relationship to projected municipal and industrial demands for water and focussed on the policy of decentralization and diversification, and specifically questioned the advisability of large-scale industrial development in Central Alberta. Approximately one-third of all the briefs presented expressed concerns about the type and amount of industrial growth projected for the region; with negative attitudes towards industrialization being especially evident in Red Deer. Not all briefs exhibited these values, and in fact several expressed a contrary stance arguing for industrial development. Overall, however, there was a strong conviction that the proposals were contrary to regional needs, would bring adverse environmental and social impacts while presenting few economic benefits and would compromise the agricultural future of the region.

The second theme was the feeling expressed by a sizeable minority that the projected industrialization was unfeasible (in the case of petrochemicals due to a declining raw material base and adverse market factors) and that the assumed levels of industrial demand for water were unrealistic. On this basis, it was argued that the need for major flow augmentation was not demonstrated at the present time.

2.2.2.2 Reactions to Flow Regulation

In those briefs which specifically dealt with the issue, the basic goal of flow regulation was supported by a ratio of three to one. This attitude essentially embodied a recognition of the problems which exist in the Red Deer River Basin, in which water supply was perceived as the most

obvious problem (especially at Drumheller). Public awareness of problems was also underscored in other discussions, but in the present context it was linked to the necessity of meeting municipal and industrial requirements. A number of qualifications were, however, attached to these positions and some of them, together with anti-flow regulation inputs, underscored the negative attitudes towards industrialization reported in the previous section (see Table 1.2).

2.2.2.3 The Consensus on Flow Regulation

The reasons behind flow regulation were brought into serious question, but by and large the basic objective itself was supported. These opposing opinion stances indicated the need for water management strategies to be integrated with land use plans, which are soundly based and acceptable to the people of the region. In the present situation then, the public opinion appeared to be that flow regulation proposals do not rest on a sound framework. Finally, it was implicit in a number of briefs, and spelled out by several, that flow regulation should not necessarily be equated with watershed management, but is only one aspect of it. This theme is developed further in the next section.

TABLE 1.1

CONCERN OVER INDUSTRIALIZATION

TOTAL	Spruce View	Sundre	Innisfail	Red Deer	Stettler	Drumheller
50	5	0	10	31	4	0

Reasons Underlying Concerns

1.	Industrial schemes are not feasible/projections are unrealistic.	23
2.	Industrial proposals are contrary to regional needs and quality of life.	16
3.	Adverse environmental impacts/pollution.	7
4.	Adverse social impacts.	7
5.	Few economic benefits/limited job opportunities.	4
6.	Destruction of agricultural land.	7
7.	Regional economy should be based on agriculture.	12

2.2.3 Alternative Strategies for Watershed Management

A fairly clear structure of choice regarding flow regulation alternatives presented by the Department of Environment was evident in the public inputs. From among the 156 briefs, three-quarters provided some evaluative reaction to the alternatives with approximately one-half providing a clear and specific indication of preference. There was a marked preference for a combination of alternatives rather than a single purpose dam site to tackle the water management problem of the Red Deer River. Lower costs, less environmental and social impact and greater flexibility to stage development as it was required, were the main reasons cited in support of the alternatives. A number of people who preferred the alternatives, however, either had some reservations about their practicality (3) or perceived the need for further studies (9) to elaborate on the proposals. There were also several others who stated they did not know enough about the alternatives or consider them (primarily because they thought the dam was a foregone conclusion) but thought they were worth further consideration. The reservations expressed about the viability of the alternatives focussed particularly on the adequacy of off-stream storage for meeting supply requirements and on the lack of flood and erosion control measures incorporated in the package.

The large majority of briefs supporting the alternatives did not itemize the particular mix of combinations they preferred to see implemented. It was clear from discussion, however, that the problems and especially those of quantity and quality are perceived as relatively separate and not amenable to a single solution. This perspective was apparent in negative reactions to dams as well as in positive preferences for the alternatives. In fact, a number of submissions which supported the dam site alternative embodied this perspective and it was particularly manifest in their adverse attitudes towards dilution as a solution to water quality problems.

TABLE 1.2

FLOW REGULATION INPUTS: BALANCE OF OPINION

		SV	Su	I	D	St	RD
For Flow Regulation	39	6	4	6	9	5	9
Against Flow Regulation	13	2	0	1	-	1	9

REASONS GIVEN IN SUPPORT OF FLOW REGULATION

1. None Given (8)
2. To overcome water supply problems: (26)
 - To meet municipal and industrial requirements (4)
 - To meet municipal but not industrial requirements (4)
 - To assist decentralization/diversification on a selective/small scale basis (4)
 - To serve regional economic diversification (3)
 - To overcome problems in Drumheller (5)
 - To ensure continued economic growth of Red Deer (2)
3. To overcome water quality problems (5)
4. To provide flood control (3)
5. To provide erosion control (2)

REASONS GIVEN AGAINST FLOW REGULATION

1. Flow regulation will be followed by industrialization (3)
2. Water supply adequate for present needs/projected needs not demonstrated (5)
3. Erosion problem is negligible (2)
4. Flow regulation and water management are not the same (3)

2.2.4 The Water Quality Issue

The issue of water quality formed a distinctive sub-theme for debate at the hearing. In such discussions, there was a clear preference for water quality problems to be tackled at their source, rather than for the expedient of dilution through flow control. This position was specifically supported by some 20 briefs identifying the main sources of pollution and linked with strategies for prevention. Agricultural land use practices along the tributaries of the Red Deer River were perceived as the main culprit in pollution - although this was disputed by several farmers - and land use controls were presented as the best means of tackling the problem (13). The discharge of municipal wastes and industrial effluents was also seen as a major contributor to deteriorated water quality (11 briefs) with the upgrading of treatment methods seen as the best course of remedial action. The nature of the debate on this issue, however, also made it clear that some definitive studies need to be done to more precisely define the main water quality problems.

2.2.5 The Location of a Dam Site

The input into this topic was specific and definite. There was a strong reaction against the location of any dam at site 6 and a contrary preference for the location of any required dam site to be located upstream of Sundre. The destruction of agricultural land and the disruption of the life style of the farmers affected were the dominant reasons cited for this stance. A large number of other reasons were also presented, but their technical validity appeared questionable. In their efforts to discredit the proposed dam at Site 6, many individuals went to considerable lengths to include as many reasons as possible to back up their stance.

TABLE 2

BALANCE OF PREFERENCE ON DAMSITES AND ALTERNATIVES

<u>Combination of Alternatives</u>								<u>Single Purpose Damsite</u>							
	SV	Su	I	RD	St	D	Total		SV	Su	I	RD	St	D	Total
For:	6	3	8	21	9	1	48	For:	3	4	2	5	0	8	22
Against:	3	2	0	3	0	2	10	Against:	5	3	9	36	2	1	56

<u>Reasons For</u>			<u>Reasons Against</u>		
1.	Lower Impact	13	1.	Doesn't solve water quality problem/pollution dilution is temporary solution	6
2.	Lower Cost	15	2.	Environmental impact	6
3.	Greater flexibility/allows staged development	14	3.	Costs (exceed benefits)	5
4.	Facilities integration/has side benefits	12	4.	Unnecessary at present	6
5.	Saves farmland	5	5.	Cause industrial influx	3
6.	Preserves wild river	2	6.	Destroy wild river	2
			7.	Permanent, irreversible structure	2

<u>Reasons Against</u>			<u>Reasons For</u>		
1.	Not viable	5	1.	Only way to achieve regular flow and supply	8
2.	Not adequate for water supply needs	3	2.	Only method of flood control	2
3.	Doesn't provide flood control	3			

TABLE 3

	Spruce View	Sundre	Innisfail	Red Deer	Stettler	Drumheller	TOTAL
For Site 6	2	0	0	3	0	8	13
Against Site 6	24	4	16	27	0	0	71
For Site 11	19	8	10	14	0	0	51
Against Site 11	3	5	0	9	0	1	18

2.2.6 Summary of Inputs

In summary, four main conclusions might be drawn about the structure of public preference and perception as expressed at the hearings. 1) A combination of alternatives is favoured against a single purpose dam site. 2) No specific guidance is given on the particular mix of alternatives which need to be implemented. 3) In the problem of water quality the preference is clearly for the problem to be attacked at source rather than tackled indirectly. 4) There is general support for an integrated approach to water-shed management. In this regard, however, there was a fairly strong feeling that the combination of alternatives proposed by the Department of the Environment may still be some distance from achieving this goal.

2.3 THE PUBLIC OPINION SURVEY

Following a public hearing, the Alberta Wildlife Conservation Authority commissioned an independent public opinion survey on the issue under discussion. The survey is designed to place the views advanced at the hearing in a broader perspective. It is undertaken by interviewing a stratified random sample of people with results that approximate those that would have been obtained if every person in the survey area had been interviewed.

In the present study a total of 546 people were interviewed in the Red Deer River Basin. The sample characterizes the respondents were representative in terms of the geographic distribution of the Alberta population and a variety of other factors. In the opinion survey conducted after the first public hearing in the Red Deer River Basin, a full report of the public opinion survey is available at the office of the Government of Alberta, Wildlife Conservation Authority, and a brief summary of results is presented in the following section.

2.3.1 Awareness and Concern About Water Management Problems

There was a marked increase in the number of people who were aware of problems with the Red Deer River Basin in 1975. In 1970, only 10% of the population was aware of the regional water problem. This is the exact opposite of the results found in the previous opinion survey of 1970, and indicates that the public was more aware of the problem in 1975.

A similar comparative change also occurred in the perception of the seriousness of the water problem in the region. In 1970, only 10% of the population was aware of the regional water problem. This is the exact opposite of the results found in the previous opinion survey of 1970, and indicates that the public was more aware of the problem in 1975.

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Following a public hearing it is the standard practice of the Authority to commission an independent public opinion survey on the issue under discussion. This survey is designed to place the views advanced at the hearing in a broader perspective. It is undertaken by interviewing a stratified random sample of people with results that approximate those that would have been obtained if every person in the survey area had been interviewed.

In the present study a total of 560 people were interviewed in the Red Deer River Basin. The sample characteristics of respondents were representative in terms of the demographic structure of the Alberta population and closely paralleled those found in the opinion survey conducted after the first set of hearings on the Red Deer River. A full report of the public opinion survey is available at the office of the Environment Conservation Authority, and a brief summary of results is presented in the following sections.

2.3.1 Awareness and Concern About Water Management Problems

There was a marked increase in the number of people who were aware of problems with the Red Deer River. Approximately two-thirds of those interviewed stated they knew of regional water problems. This is the exact converse of awareness levels found in the previous opinion survey of 1976, and particularly impressive increases were registered in the Sundre area.

A similar comparative change also occurred in the perceptions of the seriousness of water problems facing the region. Water shortage again emerged as the most evident problem, with three-quarters of respondents considering the situation very or moderately serious (compared with only 31% in the 1976 study). A similar percentage of respondents also felt that more water is required to support possible future growth in the Red Deer River Basin. Water quality was also regarded as a problem, approximately one-half of the sample group (54%) registered this opinion.

The higher group public awareness and concern over water management problems in the region between the 1976 and 1977 surveys occurred in all parts of the region. The factors underlying this change cannot be definitively identified but the independent consultant indicated that the public hearings and associated activities were undoubtedly among the key elements responsible. About one in three respondents were familiar with the Environment Conservation Authority hearings, although only 4% of the sample actually attended them.

2.3.2 Attitudes Towards Flow Regulation

Approximately one-half of the people interviewed believe that the flow of water in the Red Deer River should be regulated. This percentage represents a slight increase over the figures obtained in 1976. At the same time, however, there was also a similar increase in those against flow regulation (from 25% to 32%). In short, where previously there was some ambivalence in attitude towards flow regulation, this has now crystallized into definite stances, for or against.

Only a small proportion of respondents (14%), however, were familiar with the water management alternatives presented by the Department of the Environment. Among this group one-half indicated a preference for dam impoundment, one-fifth preferred offstream storage sites, while 6% felt that a combination of the two previous alternatives was warranted. A similar set of preference rankings was obtained from those respondents (86%) who were not initially familiar with the alternatives presented. In general, residents of the City of Red Deer were much more familiar with alternatives than those in other areas, with people in the southeast being least likely to be aware of them.

2.3.3 Expectations and Preferences Regarding Growth and Industrial Development

The amount of industrial growth projected for the Red Deer region is a key factor underlying water management problems and three-quarters of the people interviewed expected more industry to move into the region in the near

future. In terms of personal preferences for more industrial development, 60% of the respondents would like to see this occur and 29% would not. Among those who preferred more industrial growth, there were no substantial differences in the perception of benefits of large-scale and small-scale industry; although younger age groups were less inclined to prefer large-scale industry than those in older age categories. At the same time, the younger respondents were most inclined to feel that further jobs were needed in the area.

3. RECOMMENDATIONS

3.1 INTEGRATED LAND USE AND WATER MANAGEMENT PLANNING



3.1 INTEGRATED LAND USE AND WATER MANAGEMENT PLANNING

The Authority continues to firmly endorse its frequently stated policy that the use of land is an integral part of water management. There is no doubt that a river always reflects the uses of the land which constitute its drainage basin. The geological structures, climate, forests, muskegs, groundwater, farms, towns and cities together with all plant and animal life are interwoven in a complex web with the living river. The many connections between land use and its impact on the river are complex to such a high degree that virtually every land use change must, in some way, cause some adjustment by the river. These adjustments may be in changes of water quality or quantity or they may be in floods or increased bank erosion. With a growing regional economy and especially where that economy involves change in direction from rural to urban, or from agricultural to industrial, the new water demands raise conflicts in allocation.

The public recognition of the need to develop a plan in which there is an appreciation for the land use aspects of water management is endorsed by the Authority. There are several aspects to the development of such a plan which require more detailed discussion.

Primarily, the river basin as a geographic unit contains several political jurisdictions including the Regional Planning Commissions, Improvement District and Crown lands administered by the Department of Energy and Natural Resources. Within these jurisdictions, the Municipalities and the Counties carry out their own local responsibilities. The development of a plan requires not only the cooperation of the various political jurisdictions but also the cooperative inputs of all those departments and agencies of government whose activities have an impact on land use and water management. A formal committee headed by the Department of the Environment could be structured to develop an integrated land use and water management plan which reflects the inputs of all those agencies and jurisdictions within the drainage basin.

Secondly, it is most important that once such a plan is developed, it be formally endorsed by the government and that individual agencies and departments carry out their responsibilities toward implementation of the plan. It is the Authority's hope that the recommendations contained in this report will be

reflected in that plan and that the Authority could continue to play its role through public examination of an integrated land use and water management plan for the Red Deer River drainage basin.

Thirdly, there are some underlying principles in planning which must be recognized by both the public and government agencies. Plans of this nature must not be considered as static or without flexibility. The changes which take place in the evolution of our societal structures must be reflected in new approaches to land use. Natural phenomena such as climatic variability can force changes of plans. In any case, such plans should be regarded as dynamic and capable of reflecting the need for change. These plans must be living documents which regularly evolve to suit the needs of the people.

Over the years, the Authority has been a strong proponent of such integrated land use and water management plans. It has also had a history of support for multiple use of resources. These two positions of the Authority make it most difficult to consider single management strategies before comprehensive public examination of a total drainage basin is carried out. The Authority therefore concludes that future public hearings in any drainage basin must be directed towards the whole of the basin before individual strategies are examined or decided upon. It would be prudent therefore to hold public hearings in each of the major drainage basins directed to the development of integrated land use, water management and resource development plans.

RECOMMENDATIONS

1. That an integrated land use and water management plan be developed for the Red Deer River Basin with all agencies which have a responsibility in land use and water management participating in its development and that it be submitted to the public for examination prior to acceptance.
2. That a formal committee headed by the Department of Environment be assembled for the purpose of developing such a plan.
3. That the plan remain flexible and be continually reviewed and updated to meet the changing circumstances.

4. That the plan take into consideration the concerns and recommendations made in this report.
5. That the plan be formally adopted by the Government.
6. That when it is adopted by the Government all administrative agencies who have a responsibility in land use and water management in the Basin be required to follow the plan in carrying out their administrative responsibilities.
7. That the areas of administrative responsibility carried out by each administrative agency should be coordinated through some form of inter-agency referral procedure.
8. That on a systematic basis, the Authority carry out comprehensive public hearings on land use, water management and resource development in each major drainage basin in the province.

3.1 WATER QUALITY

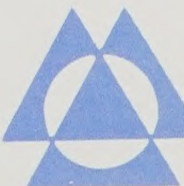
The primary concern of water quality is the degree to which water is fit for its intended use. Water quality is a relative term, and its meaning varies with the context in which it is used. For example, water quality may refer to the chemical, physical, and biological characteristics of water, or it may refer to the aesthetic quality of water. The degree to which water is fit for its intended use depends on a number of factors, including the intended use of the water, the natural characteristics of the water, and the human activities that affect the water.

Water quality is a complex issue, and it is not always clear what is meant by the term. The degree to which water is fit for its intended use depends on a number of factors, including the intended use of the water, the natural characteristics of the water, and the human activities that affect the water. The degree to which water is fit for its intended use depends on a number of factors, including the intended use of the water, the natural characteristics of the water, and the human activities that affect the water.

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3.2 WATER QUANTITY

The primary concern of water quantity is the degree to which water is available in sufficient quantities to meet the needs of the population. Water quantity is a relative term, and its meaning varies with the context in which it is used. For example, water quantity may refer to the total amount of water available in a region, or it may refer to the amount of water available for a specific use. The degree to which water is available in sufficient quantities to meet the needs of the population depends on a number of factors, including the natural characteristics of the region, the human activities that affect the water, and the distribution of water resources.



3.2 WATER QUANTITY

The amount of water which flows through any river is limited by many factors, some of which are outside the influence of man. Natural variation in flow rate can have serious impacts on both man and the natural system. Flooding and water scarcity can be cause for serious concern. There are, however, varying degrees of impact on river flows directly attributable to the activities of man. The impact of human activities is often reflected in the rate of delivery of the total water made available by nature.

Water quality is discussed separately from quantity in this report to again emphasize the Authority's position in the Preliminary Report and Recommendations of February 1976 which states, "The quality of the water should be maintained by controls external to the river itself. There are too many dangers in the argument that dilution through flow control will decrease pollution in a river for it to be an acceptable position". There is no doubt that dilution will decrease the intensity of pollution but it makes no contribution to decreasing total pollution.

The use which man and his activities make of water supplies can have important consequences because the required rate and time of withdrawal is not often coincidental with the river's ability to supply it. It is this problem which gives rise to the need for flow control or augmentation. In order to satisfy human needs, it is important that future water demands be predicted with a relatively high degree of accuracy and for a sufficient time into the future to allow for the implementation of planned strategies. The public hearings have led the Authority to question the need for increased water supplies in the immediate future. In the longer range, however, increased water demands could be met through the utilization of alternatives such as offstream storage which would provide a broad range of additional environmental benefits to the whole of the Basin.

The public opinion survey conducted for the Authority subsequent to the hearings indicated a preference for dams to control the flow of the river. However, it was pointed out that 86% of those interviewed in this survey were unaware of the alternatives available.

3.2.1 Climatic Variation

On a world-wide basis the meteorological discipline has alerted us to the possibility of climatic change of such magnitude as to seriously jeopardize the ability of man to continue his pursuits and to carry out his traditional roles and occupations in some areas. The measured Alberta climatological history is relatively short, but even in that brief period, it has demonstrated considerable variability. It is important to state that if the natural systems do not deliver the water required, man, for all his works, is left at a serious disadvantage. In order to understand the effect of climate on water management, there is a need for more detailed studies related to the province's climatology so that an adequate inventory can be established for the future.

RECOMMENDATION

1. That better climatological data be developed especially in the mountains and foothills, to assist in the operation of water management systems.

3.2.2 Watershed Impact

The condition and use of the watershed of any river will have some influence upon both the total amount of water delivered and upon the rate of delivery. Both the amount of water and the rate of delivery have been of sufficient concern in the Red Deer River Basin to be cause for the public hearings. It should be recognized that the activities of man may have long-term adverse impacts on natural systems but that these can be minimized and benefits accomplished through wise and judicious planning.

RECOMMENDATION

1. That the possible effects of man's activities on a watershed in terms of quantity and rate of flow of water, be considered fully when preparing a water management plan.

3.2.2.1 Forest Operations

The Authority will shortly be conducting public hearings on Forest Utilization and after these hearings have been held, this subject will be discussed in detail and specific recommendations made at that time. However, it is widely recognized that forest use does have impact on both the total amount and the rate of delivery of water. For some purposes, specific forest management practices may be beneficial. While it is generally recognized that burnt-out and clear-cut watershed areas deliver more water at a faster rate than a standing mature forest, there can also be associated problems with water quality, erosion and flooding. The Authority has earlier endorsed the multiple use of land and resources and recognizes that good management rather than total preservation is the key to harmonious relationships between the needs of man and environment conservation.

RECOMMENDATION

1. That forest harvesting plans continue to be improved so as to minimize watershed management problems.

3.2.2.2 Agriculture

The establishment of agriculture caused major changes in the hydrological system. The character of the watershed has been altered and some of the impact has been adverse. Some of these adverse effects were due to man's failure to understand his collective impact on natural systems and unfortunately some of these are continuing.

In the course of the public hearings, the Authority was repeatedly told of the necessity to preserve agricultural land rather than to sacrifice it to the needs of projects for river flow control. Yet, the actions of the agricultural community itself, in some cases, are part of the reason for the need for flow control. The Authority was told of past bad practices by farmers who admitted that they simply did not understand the damage they were causing.

RECOMMENDATIONS

1. That it be recognized that agricultural operations can adversely affect the amount, and rate of flow of water in a river.
2. That individual land owners recognize that even relatively small actions on their property can contribute to adverse impact.
3. That it be recognized that good land use practices may reduce the necessity for major water management schemes which may be destructive to agriculture.

3.2.2.2.1 Streams

Even the smallest tributary is an integral part of every river system. Ephemeral or intermittent drainages become important at times of heavy rain and during periods of runoff. The integrity of such watercourses must be respected if a balanced hydrological system is to be preserved. The removal of trees right to the waters edge, even on ephemeral streams, must be due either to a lack of knowledge of the hydrologic system or disregard for the needs of the total community. Lack of information can be resolved through education, both of a formal nature and by the co-operation of the total agricultural community. If cooperation is not achieved then enforcement may be necessary. However, the Authority believes that the vast majority of farmers exercise those responsibilities which go with ownership.

RECOMMENDATIONS

1. That all water courses be recognized as vital parts of the hydrologic system.
2. That the principle of preservation of natural vegetation along stream banks be promoted.
3. That as a general rule, the area of vegetative cover be increased as the size of the streams increases.

3.2.2.2.2 Sloughs, Muskegs and Wetlands

The existence of sloughs and muskegs in a drainage basin is an important part of the total hydrologic system. Frequently, sloughs are part of the groundwater recharge system which may discharge directly or indirectly into the rivers. Such movements of water have the effect of storing water in the subsurface aquifers and then delivering these same waters at times of low flow. Muskegs are even more important in this activity since they frequently form the origins of streams.

For many years, the agricultural community has been involved with the drainage of such areas and has utilized the land for crop production. It is this continuing attack upon the hydrologic system which causes increased variation in delivery rate and contributes to both floods and unacceptably low flows.

Along some streams, lowlands are regularly flooded to form fresh water marshes. Such areas are well recognized for spawning purposes where the young fish fry are offered a rich supply of food together with shelter from predation. Aquatic birds are highly dependent upon these areas for both their existence and as breeding and rearing ground. In addition, these fresh water marshes are storage areas which often attenuate the flow rates in the streams.

RECOMMENDATIONS

1. The the importance of sloughs, marshes, and muskegs in the hydrologic system be recognized.
2. That a careful evaluation of the impact on the hydrologic system be conducted before drainage projects involving lowlying lands are permitted.
3. That fresh water marshes be recognized for their highly productive biological capability including aquatic and wildlife forms, and be preserved wherever feasible.
4. That a detailed inventory of the hydrological and ecological characteristics of wetland areas be undertaken.

3.3 WATER QUALITY

The watershed of the Red Deer River is subjected to water quality variations, some of which are caused by man and some are natural in origin. Much of the quality degradation caused by man is understood now and can be overcome by better management practices. There are some aspects of natural oxygen depletion in water which are not yet fully understood or documented. An examination of the records indicate a very serious drop in the oxygen content of the river below Red Deer. The sewage effluent from the City of Red Deer does not fully account for this drop. Further study is needed to determine the cause of this oxygen depletion and to develop alternatives for rectifying it. Although increased flow may dilute the problem, the Authority feels that the problem should be resolved at the source.

RECOMMENDATIONS

1. That a study be undertaken to determine the cause or causes of oxygen depletion in the Red Deer River below the City of Red Deer and that, if possible, the problem be resolved at its source.
2. That priority be given to aeration procedures to improve oxygen content during the winter months.

3.3.1 Natural Forces

Nature itself can cause serious water quality degradation which should be seen as normal. Vast amounts of vegetation may grow and die in natural water courses and water bodies with the result that the decay of this material is highly demanding of the oxygen supplies in the water. Water may also flow from the rivers to nearby aquifers and back again during which passage contact with minerals could deplete its oxygen content. Depletion of oxygen is more noticeable during the winter when the water has little exposure to air and oxygen replenishment.

In the course of the hearings, the Authority was told that the Red Deer River suffers from oxygen depletion even above the City of Red Deer. It was suggested by consultants that this problem was due to agricultural contamination; however, this suggestion could not be supported by

measured data. A careful evaluation of all the processes which contribute to oxygen depletion should be undertaken.

RECOMMENDATION

1. That special studies be carried out to identify all the sources and the extent to which they contribute to oxygen depletion in the Red Deer River.

3.3.2 Agricultural Operations

It is well known that all organic materials can contribute to water quality degradation under certain conditions. On the other hand, organic material which degrade on or in soils are highly beneficial to those soils and seldom cause problems of decreased water quality. A major component of agricultural pollution of waters in the Red Deer River Basin is animal waste. For many years, animals have been kept in close proximity to, or given free access to water courses. Although this has been a great convenience to local farmers, it has adversely affected the water courses. The degradation is caused not only by the deposition of animal wastes in and near the streams but also by trampling on stream side vegetation causing increased erosion of stream banks.

There are several aspects of this problem which require attention. While the impact of one small farm operation may not, in itself, be significant the total effect of many such operations may indeed be quite serious.

Much attention has been given to large-scale feedlot operations and this attention may have been interpreted as meaning that small operations cause no problem and therefore require no attention. In addition, many farm operations involving livestock have no access to streams and rivers and manage successfully. There is little doubt that farms can be operated without access to water courses. However, where hardship can be demonstrated, programs of assistance to farmers who had traditionally utilized such water courses might be considered.

There is in existence a widely distributed publication jointly produced by the Departments of Agriculture and Environment in 1973 entitled "Confinement Livestock Facilities Waste Management - Code of Practice," which gives a code of ethics with reference to livestock confinement and waste management. It outlines the objective of managing livestock wastes to retain a balanced ecological system. Ideally, waste nutrients should be returned to the land for crop production and prevented from entering into fresh water supplies, both surface and subsurface. This document was issued as a guideline to livestock operators, but compliance is voluntary. It would be interesting to know how successful this document has been in controlling waste management and pollution.

Perhaps it is time to bring in more stringent regulations, particularly in areas where there is definite evidence of water contamination. The reason given for not doing so to date is the rapidly changing agricultural technology and the frequent updating of the code. The guidelines are excellent. Perhaps what is required for compliance is an intensive information campaign indicating that though at present these guidelines are voluntary, at a future date they may become mandatory by law. It might also be beneficial to compile similar guidelines to control fertilizing and spraying activities on lands adjacent to surface waters.

RECOMMENDATIONS

1. That more emphasis be given to agricultural educational programs, including mutual exchanges among farmers, directed towards keeping animal wastes away from stream courses.
2. That where existing livestock operations on water courses require relocation, consideration be given to assistance programs.
3. That all livestock confinement operations be located and operated according to the guidelines outlined in the bulletin issued jointly by Alberta Environment and Agriculture in September, 1973.

4. That agricultural operations continue to be analysed as to sources of potential water pollutants in addition to livestock confinement operations and that appropriate follow-up action be taken where sources of pollutions are identified.

3.3.3 Resource Extraction and Industrial Development

The headwaters of the main stem of the river and the Panther and Dormer tributaries are in the Banff National Park and thus are reserved for park purposes and access is limited to trails at this time. In the area outside the Park, lumbering, cattle pasturing, outdoor recreation and exploration for and production of underground resources are active pursuits. Activities relating to oil and gas resources are widespread throughout the Basin from the Banff National Park boundary to the Saskatchewan border. Current operations cover a wide range of activities including exploration, drilling, well servicing, production, gas processing, sulphur recovery and pipeline facilities. A new ethylene plant is currently under construction in the Red Deer City area at Joffre.

There are extensive deposits of coal under the Basin from the westerly extremity, east to the Garden Plain, Hanna, Sheerness areas. A number of mines have been developed; however, the market for coal started to decline markedly in the late 1940s and only a few mines are now active. There is, however, a growing interest in the coal deposits that are close to the land surface and thus can be mined by surface operations. Such deposits exist in the central part of the Basin from Ardley to Three Hills, Carbon areas east to the Garden Plain, Hanna and Sheerness regions. The market for coal, as indicated in the studies carried out prior to the public hearings, would be in coal-fired thermal electric plants and in coal gasification plants. Significant deposits of bentonite occur in the area northeast of Stettler and are being mined for use in drilling muds.

Throughout the Basin industrial development up to the present time is of a nature that has not caused serious water quality problems. Most industrial activity is carried on in urban centres where municipal water treatment facilities are available.

As growth continues, however, and if additional industrial activity is directed to the Basin, there may be problems in the suitable disposal of effluents. The history of industrial development in the province has recorded many problems of this nature. However, over the years better legislation has been developed, and there has been more effective guidance and enforcement by the Department of the Environment which together with a more cooperative attitude on the part of industry has shown positive results and good progress. For new industries in the future it is likely that increasingly stringent environmental regulations will minimize water pollution problems.

RECOMMENDATIONS

1. That the policy of requiring that new resource developments be planned in a way which strives to eliminate water pollution be continued.
2. That continuing research and investigation be carried out by industry and the Government to develop new ways to eliminate water pollution in resource developments.
3. That the work of the Department of the Environment in water quality control be recognized and encouraged, and that the present policy of licensing, enforcement and cooperation with industry towards the goal of eliminating industrial water pollution be endorsed.
4. That recognition be given to industry when it develops efficient water pollution abatement programs.

3.3.4 Urban Growth

Although it is difficult to predict with accuracy where urban growth will take place and at what speed, it can be expected that there will be some growth. Invariably, high population density produces a greater concentration of urban pollutants which can cause water quality deterioration. Over the years, sewage treatment has become more widespread and in many cases, upgraded to greater levels of efficiency. Such works are to be encouraged and should be pursued vigorously as a major step forward in water quality control.

Flow augmentation can be beneficial as one alternative to the solution of this problem, and should be considered to the extent required to accept normal amounts of adequately treated urban and industrial effluents. To this extent the need for flow augmentation on the river was earlier recognized by the Authority and endorsed as prudent. It may not, however, be justified if a better way of achieving quality improvement can be developed.

Total digestion of sewage wastes followed by aeration of effluent has proven to be successful. However, there still remains the problem of very low levels of oxygen during periods of low flow in winter. This problem should be resolved through identification and treatment of the problem rather than the symptoms.

RECOMMENDATIONS

1. That the policy of requiring communities to provide adequate effluent treatment be continually reviewed with the ultimate objective of eliminating municipal water pollution.
2. That urban communities be encouraged to fully meet provincial requirements for sewage treatment.

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3.4 FLOODS

There is no doubt that floods along the Red Deer River occurred long before any human occupation, and will continue to occur regardless of man's activities. A review of the measurements of flow in the river during the last sixty years indicate wide fluctuations which were caused mainly by climatic conditions. However, the magnitude of some floods may be increased to some extent because of the changes in basin characteristics brought about by man. It is therefore prudent to develop and apply restorative programs now which may decrease the magnitude of such floods. The process of restoration should be carried out to the degree that is consistent with existing needs for use of the land. The remaining flood problems will have to be assessed and solved in other ways.

Lands which have been cleared of normal vegetation have a tendency to deliver more of the water which falls upon them and to make such delivery at a higher rate. Some of this impact can be reduced through the restoration of vegetation, especially in the vicinity of drainage courses which are a part of the total river system. In addition, many of the natural storage reservoirs which had historically existed in the form of sloughs, muskegs and other impoundments have been drained with the result that there is a faster delivery of water to the river system. It is a good management practice to maintain some of these natural storage basins where possible and even to attempt to utilize them in local agricultural operations.

RECOMMENDATIONS

1. That while changes in the use of land are recognized as a contributing factor to the problems of recurring floods, major floods are a natural phenomenon.
2. That it be recognized that many temporary water storage systems, which had existed naturally, have been eliminated by man and this has played a role in floods in some areas.
3. That natural storage areas such as sloughs and muskegs be maintained as a method of reducing flood risk.

4. That The Water Resources Act and its regulations regarding drainage of sloughs and muskegs be made more effective and enforced.
5. That it be recognized that there are many different methods and combinations of methods to solve or at least abate the problems of flooding. Careful study should be done to select the combination of methods that will solve each separate problem more efficiently and economically.

3.4.1 Agricultural Flooding

Flooding throughout the agricultural areas of the Basin has not been of great significance. The most troubled agricultural areas have been those portions of the downstream basin where bench lands have been utilized increasingly for vegetable crop production. If this industry continues to develop, more and more bench lands will be used for agricultural production. The users of these lands should recognize that flooding may occur and should utilize the lands accordingly.

RECOMMENDATION

1. That farmers and vegetable growers recognize that lowlying bench lands in the river valley are prone to flooding and should be used accordingly.

3.4.2 Urban Flooding

Two communities in the Basin, Sundre and Drumheller, have been subjected to flooding in the past. The problems are different in the two communities as to both the origin of flood waters and the extent of the damage which occurs with floods of varying magnitude. In both locations, however, it would appear that a dam alone would not provide complete protection, and additional works such as dykes and ditches might also be necessary.

An alternative or adjunct to dams for flood control in urban settlements is the construction of dykes. The size of the dykes and their height are, of course, dependent upon the magnitude of the flood against which protection is to be provided. In general the bigger the flood the less frequently it will occur and the decision as to whether to

protect against floods which occur once every twenty-five, fifty or one hundred years, must be made on the basis of cost both in terms of money and human distress. There remains the likelihood of a cataclysmic flood against which there will be no protection. The resolution of these questions requires careful consideration by those who are likely to be affected in association with their local and regional governments, before answers are formulated.

The Authority supports the present planning procedures which prohibit urban development in flood plain areas. This policy is consistent with the Authority's recommendation of integrated land use and water management. It must also be recognized that any restrictions to development in flood plains may cause problems to urban communities which are short of developable land. A shortage of urban land can, however, be resolved in ways other than those which expose people and property to the hazard of flooding, even though such solutions may be more expensive.

RECOMMENDATIONS

1. That continuing emphasis be placed on zoning regulations which forbid urban development of flood plains.
2. That a comprehensive inventory be made to identify the flood-prone areas within the settled areas of the Red Deer River Basin where this has not already been done.

3.4.2.1 Flooding at Sundre

At Sundre, the flood threat is from bank overflows of the Red Deer River or a combination of bank overflows from Bearberry Creek and overland flows from Bearberry Prairie, southwest of the town. It was reported to the Authority that the two conditions are quite separate and seldom occurred simultaneously.

Damage from floods of a magnitude that occur once every hundred years in the Red Deer River Basin at Sundre is estimated at about \$87,000 whilst the cost of protective dyking is about \$600,000 plus the cost of the land required to accomodate the dykes.

The problem presented by floods originating with the Bearberry Creek are two-fold and it would be imprudent to endorse any plan which does not attack the whole problem. For this reason, the plan to divert Bearberry Creek around the town of Sundre appears attractive. If a dam is constructed upstream from Sundre it would alleviate most of the flooding in the mainstream but would not eliminate flooding from the tributaries including Bearberry Creek that flow into the Red Deer River below the dam site.

RECOMMENDATIONS

1. That a system of structures be considered for installation on the Red Deer River at Sundre to provide protection against major floods, of a magnitude to be determined on the basis of cost/benefit analysis.
2. That consideration be given to diverting the Bearberry Creek to bypass the town of Sundre.

3.4.2.2 Flooding at Drumheller

Drumheller is exposed to flooding because of its extensive occupation of flood plain lands. Recognition of this problem has led to the development of zoning schemes which forbid construction on such lands. Unfortunately, there are now in existence many privately owned residences in the flood plain whose removal costs would probably be prohibitive. The construction of dykes to protect against one in a one hundred year-flood would itself require the relocation of some existing buildings. On the other hand, such dykes would open up the presently restricted flood plain to development and relieve the current pressures for developable land in the town.

The Authority examined the problem at first hand in the company of the Town Engineer and a member of the Council. Clearly, the sheer magnitude of the dykes which would be needed to protect against a hundred year-flood would, in addition to causing serious dislocation of privately owned homes, give a most unsightly and unattractive appearance to the town. There would remain the possibility of a catastrophic flood which could top even these dykes. In such a case,

flood damage would be greater because of the length of time the flood waters would be retained behind the dykes. The justification for such structures is questionable. The estimated cost of the dykes is 4 million while the estimated damage from a hundred year-flood is 5.8 million dollars.

At this time, it is impossible to predict what flow control management strategies may be used on the river in the longer term future. It is possible that twenty-five years hence, a dam or other device at some location on or near the river could eliminate most of Drumheller's flood problems. Building a dyke today to protect against a hundred year-flood could therefore be a gross over reaction. A suitable compromise might be to study the benefits of a fifty year-flood dyke against its negative impact on private property and the aesthetics of the town. It is understood that a dam above Sundre would have little effect on flooding at Drumheller and a dam at Site 6 would have only partial effect.

RECOMMENDATIONS

1. That flood plain restrictive zoning remain in force.
2. That dykes to protect existing buildings in the flood plains against lesser floods than the hundred year incidence be given consideration.

3.4.2.3 Alternatives to Flood Problems

It is understood that it is impossible in Canada to obtain insurance against flood damage for buildings that are erected in a recognized flood plain. It is also understood that in the United States, flood insurance is available from private insurance companies with some form of guarantee from the Federal Government to assist in payment of claims. When flooding occurs in Alberta, the Government usually offers some form of assistance to the flood victims. It is suggested that consideration be given to a plan whereby people may be given permission to build in presently developed flood plains when the frequency of flood is 1 in 100 years or even 1 in 50 years on condition that they take out flood insurance that is sponsored by the Government. Under this plan, the person building in a flood plain would be aware of

the risk and would be assuming at least part of the cost of the risk. This procedure would allow development of some lands now withheld due to danger of floods. In case of flood damage, the Government would pay that portion of the damage that is covered by the insurance policy.

RECOMMENDATION

1. That the Government of Alberta investigate the feasibility of establishing some form of compulsory flood insurance to apply to new buildings constructed in presently developed flood plain areas.

3.5 EROSION

From the time of the retreat of the Wisconsin Glacier to the present, the forces of erosion have carved interesting and beautiful patterns into the landscape. Parts of these are now often referred to as the Badlands. Throughout the lower Basin especially, there are soils of high erosion susceptibility. At times of heavy rains and runoff, the high turbidity of the water gives an indication of the large amount of soils put into motion. Most of this erosion is quite natural and should be recognized as such. It should also be recognized that man's activities can contribute to erosion.

RECOMMENDATIONS

1. That it be recognized that in most cases, erosion is a natural and normal consequence of flowing rivers.
2. That some erosion is caused by man and should be avoided.
3. That action to repair or control erosion be determined by an assessment of each individual case.

3.5.1 Upper Basin Problems

In the portion of the river above the City of Red Deer, the nature of the river bed varies quite markedly. In the mountains, the river bed is mostly rock and therefore no longer subject to noticeable erosion. Silt loads are very light and only increase when high water reaches the unscoured portions of the river banks. Further downstream, where the river changes from a rocky bed to one of gravel and silt, it takes on a braided appearance and its course varies from year to year. Here, the land use changes quite abruptly from natural forest to increasingly intensive agriculture.

Along this reach of the river, erosion becomes quite noticeable and land losses are discernable on an annual basis. A portion of the erosion may be assumed to be due to the activity of man and these activities require examination and modification.

Firstly, the clearing of land has caused increased and faster runoff of rainfall and snowmelt thus causing greater variability in river levels. Secondly, land clearing to the

river's edge has removed the root systems which bind the soils and provide protection against erosion. Lastly, access to river and stream banks by livestock results in trampling and breakdown of the soil thus increasing susceptibility to erosion and silting. This has been particularly noticeable in the tributaries such as the Raven, Staufer Creek, the Little Red and the Medicine.

The clearing of land was necessary to accommodate agriculture. However, serious consideration should be given to the benefits and detriments before any decisions are made regarding further land clearing. Every effort should be made to maintain and, where necessary, restore healthy tree growth along the river banks. The forestry division of the Department of Energy and Natural Resources, as a rule of thumb, recommends that a strip three chains wide be left in natural cover on the banks of small streams, and five chains wide on the banks of larger streams.

The Raven River is well known for its excellent fishing and fish rearing capabilities and it is understood that the Fish and Wildlife Division of the Department of Recreation, Parks and Wildlife has developed a program for streambank protection, maintenance and restoration along this stream.

RECOMMENDATIONS

1. That where bank erosion programs are needed, they should be restricted to specific areas of concern.
2. That methods be considered to stop the clearing of trees along river banks and programs of revegetation be undertaken with priority given to critical areas.
3. That access to the river banks by livestock be limited so that degradation of the banks can be minimized.
4. That assistance in the form of advice be made available to the owners of land bordering on rivers, concerning programs of river bank revegetation and preservation.

5. That a study be made to determine more effective methods of bringing about streambank stabilization. The study would include the best methods to acquire control of critical areas and the most efficient methods to bring about their stabilization.

3.5.2 The Lower Basin

In the lower Basin, the nearly treeless prairie reflects a normally arid climate which can, nevertheless, on occasion, experience rains of great intensity and duration. The many coulees running back from the deeply incised valley to the short grass prairie, attest to the mobility of the soil in this area. The only tree growth of significance is in those areas close to the rivers and streams in the coulees, where their presence serves to diminish erosion. Such tree growth is vitally important to the maintenance of stable river, stream and coulee banks, and provides favourable habitat for much of the regional wildlife.

Conditions in the lower Basin are generally more conducive to erosion and erosion will continue to occur especially during heavy rains and high flows in the river.

RECOMMENDATIONS

1. That steps be taken to control river bank erosion only where valuable property is threatened.
2. That tree growth along the river and in coulees be protected, and further growth encouraged.

3.6 RECREATION

3.6 RECREATION

The Red Deer River Basin in its present state is well suited for various types of outdoor recreational pursuits including canoeing, camping, swimming, fishing and hunting and other enjoyment. The Basin offers many different kinds of recreation to the different parts of the River Basin that are suitable for different tourists and local people. The areas of outdoor recreation are concentrated from the upstream areas of the headwaters of the Basin to the Basins in the western portion. Some of the recreational areas are located in the Banff National Park. There are several provincial parks located along the river including Bowhead Provincial Park in the downstream area, and Red Lodge Provincial Park which is located on the Little Red Deer River near Bowhead. The Bowhead Provincial Park is located on the Red Deer River near Bowhead. Tourists are attracted each year to the Basins of Drummond. In addition there are located on the river itself and located on the River Basin are other provincial parks including the Bowhead Bay Park at Sylvan Lake, Bowhead Bay Park at Bowhead Lake, and the Little Fish Lake Park at Little Fish Lake. There are also several private camps along the river and in other locations in the River Basin.

As the development of a management plan for the Basin, the effect of any project on recreation including fish and wildlife should be given careful consideration. For example, the construction of a dam would give some benefits for some types of recreation such as boating and sailing, but would also result in a loss of some types of recreation and give benefits in the other valley in its natural state. Therefore, from the standpoint of recreation, the development of management plans for the River Basin should give priority to those management projects which would be beneficial to recreation throughout the Basin. The development of management plans should also give priority to those projects which would be beneficial to recreation throughout the Basin.

3.6 RECREATION

RECOMMENDATIONS

1. That the effects of any proposed water projects on recreation should be given careful consideration in the development of management plans for the River Basin.



3.6 RECREATION

The Red Deer River Basin in its present state is used extensively for various types of outdoor recreational pursuits including canoeing, camping, hunting, fishing and natural and scenic enjoyment. The Basin offers many different kinds of recreation in the different parts of the River Basin that are enjoyed by outside tourists and local people. The types of outdoor recreation vary considerably from the mountain areas at the headwaters of the Basin to the Badlands in the eastern portion. Some of the headwaters are located in the Banff National Park. There are several provincial parks located along the river including Dinosaur Provincial Park in the downstream area, the Red Lodge Provincial Park which is located on the Little Red Deer River near Bowden, the Dry Island Buffalo Jump Park located on the Red Deer River near Huxley. Many tourists are attracted each year to the Badlands at Drumheller. In addition while not located on the river itself but located in the River Basin are other provincial parks including the Jarvis Bay Park at Sylvan Lake, Rochon Sands Park at Buffalo Lake, and the Little Fish Lake Park at Little Fish Lake. There are many attractive campsites along the river and in other locations in the River Basin.

In the preparation of a management plan for the Basin the effect of any projects on recreation including fish and wildlife should be given careful consideration. For example, the construction of a dam would give some benefits for some types of recreation such as boating and sailing, but would also result in a loss of some types of recreation that were available in the river valley in its natural state. Therefore, from the standpoint of recreation, the development of management plans for the River Basin should give priority to those management projects where the benefits to recreation outweigh the detriments. In the development of management projects, carefully planned recreation side benefits can often be realized at little extra cost.

RECOMMENDATIONS

1. That the effects of any proposed water projects on recreation be given careful consideration in the development of management plans for the Red Deer River Basin.

2. That it be recognized that the Red Deer River Basin in its natural state is one of the prime recreation areas of Alberta and a master plan should be formulated as part of the general land use and water management plan for the Basin.
3. That tourism be promoted as a suitable industry for the Basin.

RECOMMENDATIONS

1. That the effects of any proposed water projects on recreation be given careful consideration in the development of a management plan for the Red Deer River Basin.

3.7 WATER DEMANDS

It is difficult to predict exactly what the water demand will be in the future. It is probably more important to determine the maximum need at which water demands can grow, and to assess our capability of responding to these needs in time. If it can be established that the growth of demand will be at a rate which allows time for response it is better to hold the reserves open and to make the appropriate response at the proper time. That time can be most effective if preliminary work on the available water management alternatives can be accomplished ahead of time.

Throughout the Basin, natural population growth in 1988 creates a continuously growing demand for water. There will have to be real, long water demands will be continuous while there will be short bursts of intensification. There is little doubt that the average total annual flow of the river is always far greater, or far less than needed, however, a problem arises from the variability in flows which can range from flood peaks of more than 150 cubic feet per second.

It must be kept in mind that all of the water which flows through the Red Deer River valley is not available for use within the province. The 1955 Treaty with the American Water Board for navigation it recognizes that in general, half of the flow of the Red Deer River be allowed to pass through into the province of Saskatchewan. The agreement contains some provisions for the general reduction, however, in the course of planning water development, it is important to assume that only half of what we have is available for provincial use.

RECOMMENDATIONS

1. That the rate of growth of water demand be studied to ensure that resources are available to meet the long water.
2. That the maintenance of minimum specified flows in the Red Deer River be given priority.

3.7 WATER DEMANDS



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It is difficult to predict exactly what the water demand will be in the future. It is probably more important to determine the maximum rate at which water demands can grow, and to assess our capability of responding to these needs in time. If it can be established that the growth of demand will be at a pace which allows time for response it is better to hold the options open and to make the appropriate response at the proper time. This strategy can be most effective if preliminary work on the available water management alternatives can be accomplished ahead of time.

Throughout the Basin, natural population growth in itself causes a continually growing demand for water. These will have to be met. Some water demands will be continuous while others may be short term or intermittent. There is little doubt that the present total annual flow of the river is adequate for current or foreseeable needs; however, a problem arises from extreme variability in flows which can range from flood peaks to less than 100 cubic feet per second.

It must be kept in mind that all of the water which flows through the Red Deer River valley is not available for use within the province. The 1969 Three Prairie Provinces Water Board agreement makes it necessary that in general, half of the flow of the Red Deer River be allowed to pass through into the province of Saskatchewan. The agreement contains some complexities beyond this general statement. However, in the course of planning water consumption, it is prudent to assume that only half of what we have is available for provincial use.

RECOMMENDATIONS

1. That the rate of growth of water demand be studied to ensure that responses to need can be made within the time available.
2. That the maintenance of minimum specified flows in the Red Deer River be given priority.

3.7.1 Petroleum

Water is required within the production arm of the industry for the enhancement of oil recovery. This is a process in which water demand may increase as the existing wells become depleted. At the present time, the maximum demand from surface sources is about 16.1 cfs with some additional water being withdrawn from ground water sources, some of which may be riparian in origin. There is a need to assure careful measurement of water withdrawal rates so that future planning can be most effective and the needs of other riparian users not adversely affected.

The order of priorities of water uses places domestic and municipal uses at the top of the list. At times of low flow, the use of water by consumers in lower categories can be reduced or even stopped to accommodate higher priority needs. The policy is fully endorsed as a necessary management tool.

RECOMMENDATION

1. That all water withdrawals be carried out in accordance with the terms of the permits especially in regard to rates of withdrawal.

3.7.2 Agriculture

The present water demands by agriculture are minimal, consisting of livestock watering, farm use and limited irrigation of the lower Basin. It is unlikely that the first two uses will increase dramatically. While the need for large-scale irrigation in the lower Basin may become a possibility in the long-term future, it is difficult to see much development in this area in the near future. At the present time, irrigation water users who pump out of the river have some minor problems with withdrawal in the late summer.

RECOMMENDATION

1. That assessments continue to ascertain the projected water demands for agriculture.

3.7.3 Industrial Water Needs

The assessment of industrial water needs was complicated by three factors in the course of public hearings. There was widespread discontent with proposed large-scale petrochemical development and some questions raised as to the possibility that such industry could develop beyond the one plant now under construction at Joffre. A majority of citizens who commented on the subject were not favourably disposed to the social consequences of industrial growth, nor were they convinced that more jobs would counter balance the negative impacts. On the other hand, the Chambers of Commerce and the City Councils of Red Deer and Drumheller strongly favoured industrial development in the area.

The second factor was that representatives of industry did not appear at the hearings to state their case for the need to supply water for proposed development. This lack of participation by representatives of industry gave some strength to the stated public view that large industry may not come in and that their projected water demands should be given little consideration at the present time.

The complication arises from differences among the opinions of the participants in the public hearings and those of an independent opinion poll. The results of the opinion poll favoured types of industrial growth. An anomaly existed in that the young people of the Basin were strong supporters of the need for more jobs but at the same time were about equally divided on the question of the need for industrial growth. The older population, however, tended to support the need for industrial growth.

Some representation was made at the public hearings that industry should be required at their own expense to provide for water requirements needed.

There was also representation that if facilities such as offstream storage or a dam are provided at public expense to increase the flow in the river, then industry should be required to help pay for the capital and operating cost of the facility based on the amount of water used.

Present indications are that most industrial water demands, now and for the foreseeable future, can be accommodated through alternatives to dams and that such alternatives would have broad environmental benefits over the whole of the region.

RECOMMENDATIONS

1. That industrial water needs now and for the foreseeable future be met through alternatives to dams.
2. That a continuing assessment of the public opinion covering the desirability and type of industrial development be made.

3.7.3.1 Petrochemical Industry

At the present time, one petrochemical plant is under construction near Joffre. This particular plant is, it was reported, planning to fulfill its water domestic needs from groundwater sources. However, its process water will be withdrawn from the Red Deer River. The water needs of petrochemical plants of this scale were stated to be in the order of 3 to 4 cfs on a continuous basis. The six proposed petrochemical plants would therefore require 20 cfs.

There appears to be doubt in the public's mind as expressed at the hearings as to whether the development of six petrochemical plants is feasible. An answer to this question is important to the development of water management plans for the Basin. In any case, it is to be hoped that if development does proceed, it can be at a pace which would allow accommodation through the use of several water management alternatives which are available.

RECOMMENDATION

1. That water management plans for the Red Deer River Basin continue to include an up-to-date inventory of current and projected water use by the petrochemical industry.

3.7.3.2 Coal Industry Water Demands

According to estimates, the large coal reserves of the Red Deer Basin could be utilized to develop four 1,000 megawatt thermal generating stations, two coal gasification plants and two coal washing plants. The precise locations of these plants would be dependent upon the coal fields, but all would have a high dependence on water either for cooling or for processing and washing. The coal-related plants mentioned above represent the current estimate of the total development expected for the known coal fields in the area within the foreseeable future and would, if developed, place a continuous water demand on the river system of approximately 150 cubic feet per second. If these water demands were placed upon the Red Deer River on a continuous basis, the low flows which are typical of the winter months would not be sufficient. Accordingly, a plan of flow regulation or storage, or both, would be required to provide an additional supply over the low flow period.

Offstream storage in lakes or in offstream water bodies could accommodate the needs of each of these plants. During high summer flows, water could be withdrawn at a rate which would assure supplies over the low flow periods. There may be some advantage in using the Red Deer River for warm water discharge. Thermal pollution of this type has the affect of keeping rivers open for some considerable distance downstream. In the Red Deer River, dissolved oxygen content is very low during the winter months and the condition may be improved if the water was exposed to the open air rather than being iced over.

An alternative to provide sufficient water for the coal industry would be by construction of a dam or dams on the river. Since the development of several coal projects is indefinite it is suggested that the building of a dam to manage the flow for this purpose is not warranted at the present time.

RECOMMENDATIONS

1. That offstream storage be considered as one alternative to meet water demands for coal related industrial developments.

2. That the coal industry be encouraged to provide for its own water needs through offstream storage.

3.7.4 Urban Water Demand

Water demands by urban communities are now and will for some time continue to be well within the capabilities of the Red Deer River, even at times of very low flow. At the present time, Red Deer requires 6 cfs, Drumheller a maximum of 2 cfs during the summer while a new water line will deliver about 2 cfs to communities such as Innisfail, Bowden, Olds and Crossfield. Estimated projected demands to the year 2000 are 20 cfs for Red Deer, 3.1 for Drumheller and 13.0 for the more southerly communities. This total of approximately 36 cfs is still within the capabilities of the river since the water withdrawn by Red Deer and Drumheller is not totally used, there being about 75% return to the river. Water demand problems which do arise are different at Red Deer and Drumheller and occur at different times.

3.7.4.1 City of Red Deer

From the discussions in the previous section it is concluded that the problems of water demand at Red Deer are related to technical difficulties of withdrawal at low flow periods during the winter months.

RECOMMENDATION

1. That the withdrawal works for the City of Red Deer be examined for efficiency at times of low flow with a view to improvement.

3.7.4.2 City of Drumheller

Drumheller has experienced problems in different seasons with the withdrawal of water from the river for municipal uses. The area around the city is a well-known tourist attraction and it was reported to be the third most visited area of the province after Jasper and Banff. As a result, water demands in the city can fluctuate dramatically, reaching highest levels at the peak of the

tourist season and being lowest in the winter months. The city obtains most of its water from wells which are charged by the river itself. The quality of this water is superior and relatively little treatment is required. However, when demands exceed the capability of the wells, withdrawal from the river becomes necessary. The river during times of high demand in the city is frequently silt laden to a degree which makes treatment very difficult especially during the summer months when, due to the erodability of the soils in the area, local rainstorms increase the turbidity of the water. As the city and its associated tourist industry grows, these problems can be expected to increase. The present system of wells may then prove to be inadequate while the treatment of water drawn directly out of the river at higher summer demand levels may become difficult.

This problem has already had the attention of the Department of Environment which has formulated a plan for a water storage system of sufficient volume and retention time to greatly reduce turbidity. The scheme is expensive but appears to be the only realistic long-term solution. There will be a real need for financial assistance to the city for this project.

RECOMMENDATION

1. That a suitable off-river water storage system as outlined by the Department of the Environment be considered for municipal water supply at Drumheller.

3.8 RIVER BASIN MANAGEMENT

River Basin management was referred to in an earlier section of this report. The Authority wishes to emphasize the need to keep this principle firmly in mind as individual management projects are discussed. As stated previously there is a tendency to regard large-scale projects which can have impact in a relatively short time as an overall solution to all problems. In fact the problems of the Red Deer River are varied and stem from different causes. These will have to be studied and rectified where possible as part of an overall management plan if a long range solution to the problems of the Basin is to be achieved.

RECOMMENDATION

1. That efforts be made to identify the many small contributors to water quantity and quality problems in the Red Deer Basin and attention be given to devising means for correcting them.

3.8.1 Watershed Improvement

The Red Deer River has failed in recent times to provide the regular amounts of water of a suitable quality for human use and consumption and this failure is partly a reflection of man's interference. These resources are, of course, all those components of a drainage basin which are the origin and source of the main stem. Man's degrading impact on the Basin has made it impossible for the river to provide its full bounty. In recognition of this, we must now embark upon a course aimed at the restoration of the River Basin and the preservation of its future security. No longer can we drain fresh water marshes and major sloughs indiscriminately, nor continue to remove the tree covers. We cannot continue the clearing of trees and vegetation on stream and river banks, or the degradation of streams and rivers by human and animal waste. The minor gains of individuals in convenience or slightly increased productivity of their lands must be measured against the greater public good. Indeed the impact of such actions may in some cases be felt several hundreds of miles away.

The solution requires more than merely putting an end to past practices. Past damages must be repaired. We must plant a tree, protect a bank, remove pollutants and encourage the regeneration of the biotic diversity which gives stability to the ecosystem.

RECOMMENDATIONS

1. That watershed preservation and improvement be actively pursued as a first priority.
2. That educational programs be undertaken to promote public recognition of the need for watershed management and improvement.
3. That, where necessary, incentive programs be developed to encourage watershed improvement.
4. That legislation be reviewed, consolidated, and extended where necessary to give adequate statutory recognition to the principle of good watershed management.
5. That as a final resort, enforcement measures be undertaken to ensure acceptable conservation practices are used.
6. That the areas of responsibility for the administration of watershed management programs be clearly identified and co-ordinated.

3.8.2 Inter-Basin Transfer

At present, Government policy appears to be opposed to the inter-basin transfer of water. From the environmental stand-point, the practice may have definite disadvantages but its outright rejection may not always be justified. Examination of the surface geology of the Red Deer region reveals that some inter-basin transfer appears to be occurring naturally when water from the Clearwater River moves through the intervening moraine deposits to join with the headwaters of the Upper Raven or what is locally called Stauffer Creek.

There is the possibility that natural forces could at some time cause an increase in these flows. If this occurs, a major flow of water down a limited channel such as this, could destroy what is now a superior aquatic habitat and might also cause flooding of agricultural lands. This situation should be carefully watched to prevent what could be a serious natural ecological accident.

In the long term, however, under proper control, water from the Clearwater may be able to provide a supplementary source of water for the Red Deer River during low flow periods. It should be studied and kept in reserve as a management option which might have to be used in the future.

RECOMMENDATIONS

1. That the natural movement of water from the Clearwater River to the Raven system be monitored in order that action may be taken, if necessary, to avoid a major natural breakthrough.
2. That the availability of Clearwater River water for transfer to the Red Deer River System be studied for possible use as a future management alternative.

3.8.3 Offstream Storage

Water management alternatives should always be examined for the possibility of benefits beyond those directly sought. In the present case the basic aim of offstream storage would be to improve the year-round supply and quality of water for the City of Red Deer for some proposed thermal-electric developments and for the river itself. Offstream storage proposals are an attractive water management or flow enhancement tool because of the many side benefits which can result. Some disadvantages include the energy required for pumping, a possible loss of peripheral agricultural land and temporary destruction of some wildlife habitat.

In the course of the hearings, the Authority received public representations supporting offstream storage especially at Stettler, with reference to Buffalo Lake. There was also a recognition of the additional benefits in enhanced

recreation and improved aquatic habitat. The Authority supports these public views. Many possible sites for off-stream storage exist and were described in the public information bulletins prepared by the Department of the Environment. For the immediate future, the use of Sylvan and Buffalo Lakes for this purpose are suggested as having good potential. It was also suggested that industry might provide its own offstream storage reservoirs using river water pumped during the summer for winter-time use.

RECOMMENDATIONS

1. That offstream storage in existing water bodies be endorsed as a favourable water management strategy.
2. That in the benefit/cost calculations accompanying offstream storage plans, ample weight be given to the environmental, recreational and aquatic and wildlife habitat enhancement which might result.
3. That general approval be given to the concept of offstream storage in the Sylvan and Buffalo Lakes.

3.8.3.1 Sylvan Lake

The lake has a surface area of about 10,000 acres and a normal annual fluctuation level of about one foot. There are, of course, times when these limits are exceeded during which the recreational benefits on the lake are affected. The lake is a well-used public recreation area and has a number of well-developed cottage communities along its shores. Water quality is generally good.

The proposed storage scheme consists of a pipeline from the river to the south end of the lake. During low flow periods in the Red Deer River, water would be delivered by return pipeline to the water treatment plant of the City of Red Deer. The pumping and withdrawal of 5,000 acre feet on an annual basis would superimpose a 6 inch level change upon the existing natural variation.

The movement of water from the Red Deer River into Sylvan Lake is expected to have little effect on the quality of water in the lake itself. There are, however, other considerations which deserve attention, an important one being the impact on Signet Lake. This lake is a prime marsh which has a highly productive range of existing aquatic life. This marshy lake has been receiving attention for some time from farmers wanting to drain and reclaim the rich bottom soils for agricultural use. In an earlier section, the Authority has expressed its criticism of the practice but raises the question now to assure that lake storage will not have a serious negative impact upon this fresh water marsh. At the present time, there is general agreement as to the acceptable levels of Signet Lake and these levels should be adhered to. The agreement as to the acceptable levels represents a co-operative solution by the Departments of Environment, Agriculture, and Recreation, Parks and Wildlife.

Additional advantages may be gained from the scheme in lake stabilization. There have been years when the levels of Sylvan Lake have been either too high or too low. The water storage scheme could, in addition to assuring water for the City of Red Deer, be used to raise lake levels in years of deficiency or to lower them when there is an over-abundance of water.

RECOMMENDATIONS

1. That offstream storage of water in Sylvan Lake be given consideration because of the many environmental and recreational benefits that would be realized to the lake and the river as well as the provision of a future auxiliary supply for the City of Red Deer during low flow periods.
2. That the proposed plans for such a project include the capability of maintaining suitable lake levels.

3.8.3.2 Buffalo Lake

In the list of management alternatives proposed for the Red Deer River, water storage in Buffalo Lake was put forward as a means of supplying water on a year-round basis to the coal-related industries. However, during the public

hearings it was made clear to the Authority, especially at Stettler, that an enhanced recreational capability in the lake was more important to the residents of the area than to the needs of the coal industry.

The wide variability of climatic changes in the Buffalo Lake region has had some adverse impact on the water quantity, quality and productivity. It was related to the Authority that the lake has a history which at times was rich in the production of fish, birds and mammals. The lake has been a good fishery having supported what was, in its time, a commercial sized yield. It had a natural connection to the Red Deer River through Tail Creek which was used as a spawning run for fish. In the past, Buffalo Lake has been subjected to periods of very poor water quality. This has been attributed to the ingress of nutrients from agricultural operations. It was stated, however, by senior citizens that water quality degradation was due to the inundation of large vegetated lowlands at times of high water and consequent turbidity, and increase oxygen demand from decaying vegetation.

The lake has the interest of many people. A provincial park on its southerly shores has undergone flooding and probably will have to be relocated under a water stabilization scheme. The residents of the Summer Village of Rochon Sands have a keen interest in the lake levels as do a large segment of the population within reasonable driving distance who use the lake as a summer recreational area. Wildlife biologists are interested in its migratory birds and fish populations. These diverse interests may suggest conflicting desired lake levels or variations in level. Those various departments and agencies which have interest should endeavour to agree on a lake level which will bring the maximum benefits to all interests. At the present time, the Authority was informed that an elevation of 2,561 to 2,562 appears to provide optimum conditions for most purposes with a variation of plus or minus 18 inches. The use of shorelines after stabilization should be controlled to protect migratory bird nesting.

RECOMMENDATIONS

1. That Buffalo Lake stabilization be considered at an early date because of the many environmental and

recreational benefits that would be realized, including increased water supply to the Red Deer River during periods of low flow.

2. That the planning be carried out in conjunction with all departments and agencies which have an interest in the lake so that maximum environmental benefits may be achieved.

3.8.4 Groundwater

Several groundwater aquifers within the Basin are utilized for municipal water supplies. Among these are the aquifers associated with the Red Deer River itself. The Authority will pursue groundwater considerations in greater detail during its public hearings on this subject which are planned for the near future. It is considered that water quantity and flow enhancement sufficient for the present can be accomplished without groundwater considerations.

RECOMMENDATION

1. That groundwater not be considered for flow augmentation of the Red Deer River at this time.

3.8.5 Dams

In considering water storage projects as part of a water management program it should be recognized that in addition to the flow regulation value there will be additional benefits. However, there will also be some adverse effects. This, of course, applies to both on-river and off-river storage units.

After two public hearings concerning flow augmentation of the Red Deer River, it is clear that there is considerable public concern over the construction of dams. When faced with a choice, however, they would prefer a location above the town of Sundre. In the course of the hearings, the Authority was not convinced that sufficient public attention had been given to upstream sites other than Site 11. However, there is little doubt that a site upstream of Sundre would be accepted while rejection of Site 6 and 7 was both strong and widespread except at Drumheller.

In its deliberations regarding the suitability of Sites 6 and 7 for a potential dam, the Authority endorsed the principle that prime agricultural land should not be permanently put out of production where a suitable alternative was available. In the case of the Red Deer River, suitable alternatives exist including alternate damsites above the town of Sundre. The Authority was also influenced by the almost unanimous expression of public disapproval at the hearings for any action which would disrupt the closely-knit communities in the farming areas of the middle Basin.

The apparent lack of justification for increased minimum flow for any purpose other than quality improvement, and poor prospects for secondary benefits such as major recreational or power generation or improved flood or erosion control, were further factors which prompted the Authority's conclusion that if a dam has ultimately to be built on the Red Deer River, it should preferably be located at a site other than Site 6 or 7.

It must, however, be recognized that such organizations as the Cities of Red Deer and Drumheller, the Chambers of Commerce of Red Deer and Drumheller, and the Red Deer Regional Planning Commission all gave their support to Site 6 as their preferred location for a dam to achieve flow control and quality improvement in the Red Deer River.

A dam at a location above Sundre may be needed in the future and that need will be determined by the water demands which may be placed upon the river as urbanization or industrialization proceeds. Another factor is how the land in the Basin is used and how conscientious the land managers are in their efforts to maintain and improve the watershed for the purpose of enhancing both the quality and the quantity of water.

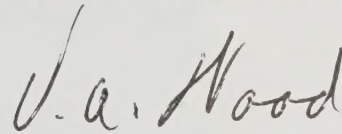
The rate of growth of water demands should allow the planners to keep their options open to respond to the needs as they arise, rather than to build an irreversible structure in anticipation of demands which may or may not arise. At a damsite upstream of Sundre, preliminary engineering and planning can be performed now in preparation for later construction when the need has been confirmed. This would materially shorten the lead time necessary to implement the plan.

RECOMMENDATIONS

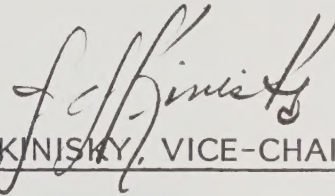
1. That Site 6 and 7 no longer be given consideration as potential damsites, now or for the foreseeable future.
2. That planning and design for a dam upstream of Sundre be undertaken so that the lead time necessary for its installation at a later date can be reduced.

The Authority wishes respectfully, to place these recommendations before you.

ENVIRONMENT CONSERVATION AUTHORITY



DR. V.A. WOOD, ACTING CHAIRMAN



J.J. KINISKY, VICE-CHAIRMAN



M. NOBLE, MEMBER

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Alberta. Environment Conservation Authority.
FLOW REGULATION OF THE RED DEER RIVER : Report
Recommendations 1977.

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